International Journal of
Science and Engineering Investigations vol. 5, issue 58, November 2016

ISSN: 2251-8843

Assessment of Heavy Metals Concentration in Lettuce Plaint in the Irrigated Agriculture at Gombe State, Nigeria

Mohamed Abdelmohmoud Elshekh[1], Shaker Babiker Ahmed[2], Salah Abdelrahman[3], Abdelmorem Elamin Mohamed[4], Babangida Hammari[5]

[1,3]Associate Professor, Agric. Eng. Department, Faculty of Agricultural Technology, University of Elneelain, Sudan

[2]Assistant Professor, Agric. Eng. Department, Faculty of Agric., Omdurman Islamic University, Sudan

[4]Associate Professor, Dept. of Agric. Eng. Departed, Faculty of Agriculture University of Khartoum, Sudan

[5]PhD Student, Gombe state, Nigeria

([2]shaker33@gmail.com)

Abstract- The study was conducted at Gombe state, Nigeria dunning the period (2014-2015). The objective was to assess the concentration of heavy mutants (Zn, G, Cd, As, Fe, Cu, Ni, Pb) in lettuce plant at three zones namely, Gombe north, Gombe central and Gombe south. From each zone four locations were selected.

Plant samples were taken randomly from the selected locations and replicated thrice. The collected samples of lettuce plant were analyzed in standard laboratory analysis. The study results showed that the heavy metals concentration in lettuce were in descending order of Fe > Zn > Cu > Pb > Cd > Cr > Ni > As and all the heavy metals are within the permissible limit of food standard committee and WHO. The results showed that the daily heavy metals intake of Zn, Cu, Cr, Ni and Fe were below the recommended limit of RDI and the transfer factor of all heavy metals was less than one.

Keywords- *heavy metals content, daily heavy metal intake, transfer factor, permissible limits*

I. Introduction

Heavy metals are metallic elements that are present in both natural and contaminated environments. In natural environment, they occur at low concentrations. However, in contaminated environment, the concentrations of the element are high, Hutchison (1980). Heavy metals accumulated with time in soils and plants due to waste water irrigation and absorbed minerals (Lokeshwari and Chandrappa, 2006). Vegetables take up heavy metals and accumulate them in their edible and non-edible parts in quantities high enough to cause clinical problems to both animals and human beings. Mohamed and Ahmed (2006) reported that the heavy metals not only affect the nutritive values of vegetables but also affect the health of human beings and therefore, the safe limits of their heavy metals should be lowered regularly in these vegetables. This regulation is the responsibility of national and international authority. Recently pollution of the general environment has gathered and increased global interest. In this respect, contamination of agricultural soil with heavy metals has always been considered a critical challenge in the scientific community (Farukel at., 2006). Due to the cumulative behavior and toxicity of heavy metals, they have a potentinally hazardous effect not only on crop plants but also on human heath (Das *et al*., 1997). Even heavy metals increase plant growth like Cu, Mn, Mo and Zn can be toxic at high concentration. Unlike other pollutants that are visible, heavy metals may bio accumulate in vegetables crops to toxic levels unnoticed considering the productions level and consumption of the vegetables. Pollutants has reached the level while is toxic to humans and ecosystem, therefore, measurement of the toxic of the heavy metals pollutants form the plant can aid in the assessment of the environment and to find out the activities leading to this problem.

The objective of this study is to determine the concentration and distribution of heavy metals in plant (lettuce).

II. MATERIALSA NDMETHOD

A. Materials

- Hydrometer
- Boiling tubes
- Motor and pestle
- 2mm stainless steel sieve
- Block digester machine
- Buck scientific Vip Model.
- Polythene bags
- Oven drier
- Plastic bottles
- Atomic Absorption spectrophotometer machine (AAs)

B. Reagents

- H_2So_4 Tertraoxo sulphate (v) acid
- HNO_3 Trioxo nitrate (v) acid
- HCL Hydro cloricacid
- Distilled water

C. *Study Area*

The research was conducted in Gombe State، Nigeria in the period (2014-2015) Gombe State is located within the latitude 9^o 30and 12^o 30^oN and longitude 8^o 45 and 11 ^{o}45 E in the sub-Sudan Gombe savannah region at the North east region of Nigeria, the attitude is 400-500_m above sea level, (yahya,2005).

The area is underlain by basement complex structure in the south and sedimentary chad formation in the north-eastern part of the state (Umar 2003).Annual average full 850 mm and temperature ranges 17^oc to 42^o c. The soil of Gombe state is underline by keri –keri chad formation. The vegetation of the area is of several types consisting of complex. Composite of thick Acacia shrubs and open grassland. The vegetation is predominantly of tree species of fine leaf. Thorny trees selerocengapurce (Danya), Suberiana Spp (Fara Kaya), Bompercostatun (GurJiya), Acacia albedo (Gawo) Acacanilotica (Gabaruwa).

The vegetation in most cases is interrupted with farming activities, indiscriminate deforestation, bush burning and other construction purposes. [27]

D. *Plant sampling*

Plant samples were taken from the three senatorial zones in the state namely: Gombe north, Gombe central and Gombe south. For each centralization four locations were randomly chosen.

Plant samples were randomly collected from the locations. The samples were washed with tap water first and then followed by double washing with distilled water and oven dried at 80^o c for 72 hours before chemical analysis.

The dried samples were grind sieved with a 0.5_{mm} mesh to attain affine powder. The sieved samples were well labeled and stored for laboratory analysis (Dean, 2013) this was repealed thrice

E. *Heavy metals determination in plant samples*

Five gm of the each dried, sieved and grinded plant (Lettuce) samples were placed in 100 ml beaker, 15ml of HNO_3, $H2So_4$, and HCL mixture (5.1.1) of tri-acid were added and the content heated and digested gently at low heat on digestion block machine for about 2 hours at 80-100°C until transparent or colorless solution was obtained. After cooling, the digested sample was faltered using what man No42 filter paper. Then it transferred to a 100 ml volumetric flask and filled with distilled water. The digested sample transferred into plastic 100 ml bottle to determine the heavy metals at their respective wavelength using A.A.S machine (USEPA, 1996).

F. *Daily metal intake (D/metal)*

It was estimated by a daily intake up at least 400 gms vegetables (Sharma *et al.*, 2008) and calculated as follow:

D / metal = 400gm + concentration of metal in vegetables.

D / metal = Daily metal concentration (gm).

400 gm. = Standard (Sharma et al, 2008.

G. *Transfer Factor (TF)*

Metal concentrations in the extract vegetables were calculated on the basis of dry weight (mg Kh-1). It calculated as follow:

$$TF = \text{C.}\left(\text{vegetables}\right) / \text{C}\ \left(\text{soil}\right)$$

Where:

C: vegetables is metal concentration in vegetables (mg kg-$^{\mathbf{1}}$)

C: (Soil) is metal concentration in soil (mg kg-$^{\mathbf{1}}$) (Kui *et al.*, 2004).

III. Statistical Analysis

The date was replicate as mean stander error and the coefficient of variability (CV%). Analysis of variance (ANOV) was used to determine significant difference between group considering a level at significance of 5% (P= 0.05) by using SPSS.

IV. Results and Discussion

Table (1) shows the mean metal can concentrations Zn, Cu, Fe, Cd, Pb, Cr, Ni and As in Lettuce at the three senatorial zone. Each with a mean as follow:

Zn (5.78), Ca (2.47), Fe (7.65), Cu (0.34), Pb (1.43), Cr (0.23), Ni (0.12) and As (0.70). Zn, Fe and Pb were highly variable with a CV% 45.27, 47.32 and 62.89 while Cd, Cr, Ni and As were moderately variable, each haring a CV% 34.76%, 29.37%, 22.05% and 31.49%. Only cu recorded low variation across the zones (CV% = 11.54%). Heavy metals content in vegetable (Lettuce) throughout the study zones showed a significant deference at (P = 0.05) was observed between the concentration of heavy metals in lettuce in the studied zones and Gambe central recorded higher heavy metal content in lettuce than other zones.

At location level, Dukku location recorded higher content of Lettuce heavy metals than Kwami and Funakaye location at Gambe north zone. At Gambe central zones, kwadon location had higher heavy metals content (lettuce) than the other location.

On the other hand, Balanga location of Gambe south zone recorded higher lettuce heavy metals than Kaltungo and Billin zone. The order of level of heavy metals in lettuce was Fe > Zn > Cu > Pb > Cd > Cr > Ni > As.

Heavy metals content of plant can be affected by several factors including metal concentration in soils, soil pH, cation exchange capacity, organic matter content, types and varieties of plant and plant age. It is generally accepted that the metal concentration in soil is the dominant factor. Heavy metals availability can also be directly affected by plant itself. In the present study, it was observed that the concretization of Pb in lettuce was higher than the Cd. In general, different areas had a concentration of Pb higher than that of Cd (Demi rezen and Aksoy, 2006). The lettuce Pb and Cd concentrations were found to be higher than the maximum limit.

TABLE I. HEAVY METALS CONCENTRATION IN LETTUCE AT THREE SENATORIAL ZONES OF GOMBE STALE (NIGERIA)

Location	Zn	Cu	Fe	Cd	Pb	Cr	Ni	As
Gumbo north	4.47	2.19	7.15	0.22	0.80	0.17	0.11	0.06
Gumbo central	7.97	2.76	11.50	0.36	2.46	0.30	0.45	0.10
Gumbo south	3.40	2.46	4.31	0.45	1.03	0.21	0.10	0.06
Mean	5.28	2.47	7.65	0.34	1.43	0.23	0.12	0.07
SET	0.80	0.10	1.21	0.04	0.30	0.02	0.01	31.49
CV%	45.27	11.54	47.32	34.76	62.89	29.37	22.05	31.49

But lower than the values reported by Singh and Kumar (2006) who reported that the values of Pb and Cd content in spinach ranged between 1.7 and 7.0 and 2.0 and 7.1 $mgkg^{-1}$ respectively The Cr concentration of lettuce found in the study areas were lower than (FAO/WHO, 2001) limits but in agreement with the ranged given by Nagajyoti *et al* (2008) who found Cr concentration in five leafy vegetables ranging between 0.89 to 1.08 $mgkg^{-1}$.

Singh and Kumar in (2006) concluded that soil irrigation water and some vegetables from peri-urban sites are significantly contaminated by the heavy metals i.e. Cu, Cd, pb and Zn. The heavy metals not only affect the nutritive values of vegetables but also effect health of human beings and therefore, the state limits of those metals are lowered regularly in these vegetables by National and international regularly authority (Mohammed and Ahmed,2006).Different vegetables had different ability and capacity in accumulated different metals.

Some plants are hyper-accumulators, (cabbage), while others are mono- accumulators Benzarti *et al.* (2008) showed that the concentrations of Cd in alfalfa, lettuce, radish and T. caerulesens increase with increases in dose of Cd in soil.

A. Heavy meals Concentration in lettuce at the Gombe north senatorial zone ($Mgkg^{-1}$)

TABLE II. HEAVY METALS IN LETTUCE GOMBE NORTH

Location	Zn	Cu	Fe	Cd	Pb	Cr	Ni	As
Dukku	5.26^{a}	2.75^{a}	8.88^{a}	0.21^{b}	0.93^{a}	0.18	0.11^{a}	0.06
Kwami	3.87^{b}	1.28^{b}	5.26^{a}	0.18^{b}	0.84^{a}	0.16	0.09^{ab}	0.06
Funakaye	4.29^{b}	2.54^{a}	7.30^{a}	0.27^{a}	0.63^{b}	0.18	0.12^{a}	0.05
Mean	4.47	2.19	7.15	0.22	0.80	0.17	0.11	0.06
SET	0.24	0.27	0.60	0.02	0.05	0.01	0.01	0.01
Cv%	16.02	36.30	25.39	20.83	19.24	6.66	14.32	10.19

Source: Field work (2014)

Table (2) showed a significance difference at (P = 0.05) observed between the means metal concentrations in lettuce at Gombe North senatorial zones. Statistical analysis shows that Dukku location recorded the higher mean content of Zn (5.26), Kwami and Funakaye recorded 3.87 and 4.29 respectively with the variability 16.02. From table (3) we can also observe that Cu and Fe metals concentrations statically at Dukku and Funakaye recorded almost same Cu and Fe metals concentration statically higher than kwami location soil Cd ranged between 0.18 - 0.27 (mean = 0.22^{-1}) which show a moderately variation (CV%=20.83%) Dukku and kwami did not differ but had lower significant Cd concentration than Funakaye. A low variation (Cv% = 19.24%) of Pb concentration in lettuce at Gombe North were also found.

B. Heavy metal in lettuce in Gombe central

TABLE III. CONCENTRATION OF HEAVY METAL IN LETTUCE AT GOMBE CENTRAL SENATORIAL ZONE ($MGKG^{-1}$)

Location	Zn	Cu	Fe	Cd	pb	Cr	Ni	As
Akko	8.25a	3.21a	11.25b	0.31b	1.35b	0.31b	0.18a	0.12a
Kwadon	9.38a	2.88a	10.10b	0.42a	2.30b	0.22b	0.13b	0.09b
Dadin	6.21b	2.18b	13.15a	0.36b	3.73a	0.38a	0.15b	0.08b
Kowa								
Mean	7.95	2.76	11.50	0.36	2.46	0.30	0.15	0.10
SET	0.54	0.18	0.51	0.02	0.40	0.03	0.01	0.01
Cv%	20.22	19.08	13.39	15.16	48.70	26.44	16.41	21.53

Source: Field Work (2014).

Table 3 showed that the pattern of heavy metals concentration differed significantly. The content of Zn and Cu metals did not vary statistically at Akko and Kwadon locations, but lettuce mean of Zn and Cu content significantly higher than Dadin-Kowa.In table 3 also we can observed that Akko and Kwadon recorded almost the same Fe and Pb metal concentration whereas Dadinkowa location recorded Pb and Fe metal concentration lower than the other locations studied. The lettuce Cd concentration found at Kwadon was statistically higher than lettuce Cd content at DadinKowa table (3). Cr ranged between 0.22 $mgkg^{-1}$ to 0.38 $mgkg^{-1}$ with a mean of 0.30 $mgkg^{-1}$ and a CV% of moderate variability (26.44%). Dadinkowa and Akko location recorded (0.33), (0.31) Cr concentration in lettuce respectively, whereas in Kwadon soil Cr concentration registered the lowest value (0.22). Form the same table also we can observed that the means of Akko lettuce Ni and As concentration are higher than the mean concentration of Ni, As in the other locations.

C. Heavy metals in lettuce Gombe south

TABLE IV. LETTUCE HEAVY METALS CONCENTRATION AT GOMBE SOUTH SENATORIAL ZONE ($MGKG^{-1}$)

Location	Zn	Cu	Fe	Cd	Pb	Cr	Ni	As
Kaltungo	1.52^b	3.78^a	0.09^a	0.44^b	0.06^b	0.04^b	0.04^b	0.02^b
Billiri	1.34^b	0.75^b	4.23^b	0.14^e	0.93^b	0.08^b	0.06^b	0.04^b
Balanga	7.34	2.85	8.61^a	0.76^a	2.11^a	0.52^a	0.21^a	0.12a
Mean	3.40	2.46	4.31	0.45	1.03	0.21	0.01	0.06
SET	1.14	0.02	1.42	0.10	0.34	0.09	0.03	0.02
CV%	100.39	63.10	98.85	69.42	99.57	124.84	89.92	88.19

Source: Field work 2014

The lettuce heavy metals concentration at the Gombe south senatorial zone showed the same pattern in the other zones. Kaltungo and Billiri lettuce heavy metals concentration (Zn, Fe, Pb, Cr, Ni and As) did not differed statistically but had recorded lower mean concentration than Balanga with a CV% percentage of Zn (100.39), Fe (98.85), Pb (99.57), Cr (124.84), Ni (89.92) and As (88.19). Cu metal concentration in lettuce at Gombe south senatorial zone (Table 3) was highly variable (CV% = 63.10%). Kaltungo and Balanga lettuce Cu contort (3.78) and (2.85 mgkg-1) are statistically the same and significantly higher than Billiri (0.75). Balanga also content significantly higher Cd content 0.76 than Kaltungo. On the other hand Kaltungo 0.44 whereas Billiri location recorded the lowest Cd content 0.14 with a coefficient of variability of 69.42%.

D. Heavy metals from soils to vegetables in the studied zones

TABLE V. TRANSFER FACTORS (TF) OF THE HEAVY METALS FROM SOILS VEGETABLE COLLECTED AT THE THREE SENATORIAL ZONES.

Vegetable	Zn	Cu	Fe	Cd	Pb	Cr	Ni	As
Lettuce 1	0.34	0.36	0.26	0.46	0.15	0.47	0.52	0.26
Lettuce 2	0.57	0.48	0.55	0.56	0.77	0.94	0.65	0.56
Lettuce 3	0.45	0.68	0.33	0.83	0.39	0.72	0.50	0.38

Source: Field work 2014. The number 1.2 and 3 indicate the zone where the lettuce was collected. (1 = Gombe north, 2 = Gombe central, 3 = Gombe south).

E. Transfer factors (TF) of the heavy metals from soil vegetable

The results in table 5 revealed that all the metals studied had a transfer factor less than 1. The value obtained were ranged from 0.34 to 0.57, Zn, 0.36 to 0.68 (mean=0.52) Cu, 0.26 to 0.55 (mean=0.41) Fe, 0.46 to 0.83 (mean=0.65) Cd, 0.15 to 0.77 (mean=0.46) Pb, 0.47 to 0.94 (mean=0.71) Cr, 0.52 to 0.65 (mean=0.59) Ni and 0.26 to 0.56 (mean=0.41) respectively the highest ratios were observed for Zn, Fe, Pb, Cr, Ni and As in lettuce grown at the Gombe central senatorial zone, while Cu and Cd at the Gombe south senatorial zone recorded the highest value. The ability of a metal species to migrate from soil roots plant root is referred to as transfer factor (TF). The factors are based on the roots uptake of the metal and discount the foliar absorption atmospheric metal deposited. (Lokeshwari and Chandrappa, 2006; Awode, *et al.*, 2008). The transfer (TF) of the heavy metals from soil to lettuce in this study which presented in table (5) show that the higher value (FF) was observed for Cd (0.94) which at Gombe central senatorial zone site while the lowest was in pb (0.15) at Gombe North senatorial zone site. According to Sajjad, et al., (2009) if the transfer factor of a metal is greater than 0.50, the plant will have a greater change of the metal contamination by anthropogenic activities. This indicates that the concentrations of heavy metals in the plants are low but, there is a change of it's to be contaminated.

F. Daily metals intake in the senatorial zones of the studied

TABLE VI. DAILY METALS INTAKES ESTIMATE (D/METAL) AT THE GOMBE SENATORIAL ZONES (MGDAY^{-1})

	Zn	Cu	Fe	Cd	pb	Cr	Ni	As
MRi	18	1.2	-	0.012	0.18	90	0.12	
UL	40	10	45	-	-	-	3.7	-
RDI	11(8)	0.9	8(8)	-	-	-	-	-
1	1.79	0.88	2.86	0.09	0.32	0.07	0.04	0.02
2	3.19	1.10	4.60	0.14	0.98	0.12	0.06	0.04
3	1.36	0.98	1.72	0.18	0.41	0.08	0.04	0.02

Numbers in braeket (s) indicates RDl for remarks.

The number (1, 2&3) indicates the zone where the lettuce was sampled

MRL = Maximum Recommended Levels

UL = Upper tolerable daily intakes

RDI = Recommended Daily, metals intakes for females

1 = Gombe North Senatorial zone

2 = Gombe Central Senatorial zone

3 = Gombe South Senatorial zone

G. Daily metals intakes

Table (6) showed the daily metals intake of Zinc (Zn) was found to be below the recommended RDI of 8-11 mg day1 (FNB, 2001).The vegetables had D/metal value ranging between 0.15-0.97mg/day. Results Show that the levels of Zinc (Zn) in lettuce range from 1.34-1to 9.36-1 respectively. Result from this study compared With studies done by Akubugwo et al (2012) on Amarinthus hybridus vegetables whish reported values of Zn of 1.06+0.02 to 2.82+0.01mgkg-1 Muhammed et al (2008) also reported the amount of Zn in leaf vegetable samples as 0.461 (Spinach), 0.205 (Cariander), 0.743 (lettuce), 1.893 (Redish) 0.777 (Cabbage) and 0.678 (Cauliflower) respectively. However, it could be observed that the daily metal intake of Zn is below the permissible limits recommended by various agencies. (Friberg et al, 1984; Food and nutritional board 2004; USEPA, 2010; WHO, 1993, 2004).

Copper had upper tolerable daily intake at than 10 (FNB, 2001). Similar results have been reported by Uwah*et al.*, (2011) who reported Copper (Cu) values between 0.81 mgkg^{-1} and 1.75 mgkg^{-1} in spinach and lettuce grown in Nigeria (Akubgwo*et al.*, 2012).

On (Fe) daily metal intake also is within the permissible limits and it range from 72 to 2.2% mg/day across the areas studied. Similar results with those in this were reported by Aweng*et al.*, (2011) which recorded an Fe content of 0.65-2.7 mgkg-1 in fruits vegetables. Tsafe*et al.*, (2012) reported an Fe content of 15.96 Fe 0.18 -1 in Amaranthus caudatus and values at 42.86 = 0.27 mgkg-1 in Lactuca Sativa vegetables.

Akubugwo*et al.*, (2012) reported even higher Fe metal content of up to 147.41+0.01 -1in Amaranthus hybridus. The rate of metals up taken by vegetables could have been affected by other factors such as plant age, plant species, soil pH, nature of soil and climate.

Cadmium (Cd) and Lead (Pb): The daily metal intake of Cadmium (Cd) and lead (Pb) prescribed in table 6 indicated that there were above minimal Risk levels (ATSDR, 2009) and (USEPA) respectively. The typical daily intakes of Pb by adults range foam 0.015-0.1 mgkg^{-1}, depending on the composition of diet and where the consumer lives (Codex, 1995).

Chromium (Cr) concentration in lettuces from the areas studied were generally low and the daily useful intakes of Cr from the vegetables were about <50% of the estimated typical daily intake rates of 0.025 -0.2 mgday^{-1} (Codix, 1995). Thus, approximately <50 or > 50% of daily Cr intake from foods tuffs could come from the leaf vegetable grown at the study areas.

The daily metals intakes of Nickel (Ni) and Arsenic (As) presented in table 6. Hence different vegetables are consumed variably by different segment of population at different time throughout the year, so it may be a realistic estimate for the average intake of metals from vegetables. It may be how ever been seen in table 6 that the intake of toxic metals except Cd and Pb from the vegetables is not high and which permissible limits recommended by many agency (FNB, 2001) WHO, 1993; AST, 2000) Nickel are found in small quantities in many food stuffs (0.001-0.01 mgkg-1) but in higher concentrations in food stuff such as grain, nuts and seeds (up to 0.8 mg kh-1). National food Agency of Denmark, 1995). Welgert (1991) indicated that Ni concentrations of up to 68 mgkg-1 may still be safe for consumption since more than 90% of Ni taken in is held in the organic form than can be safely excreted.

V. Conclusion and Recommendation

- The results of this paper suggested that significant differences existed in the heavy metals concentration in plant (Lettuce).

- Among the heavy metals studied lead and cadmium were above the toxicity level in lettuce.

- The daily intake of Zinc, copper and Ferric through the edible lettuce in the study zones may not cause health hazard for consumers because the value blow the recommended daily intake of the metals.

- Transfer factor was below 1.00 (one).

- Regular mentioning of heavy metal. In plant is existential in order to prevent excessive build-up of these metals in the human food chain.

- The study added data serve as base line information in this field.

References

[1] AKubugwo, E.I., obasi, A; chinyere, G.C., Eze, E., Nwokeyi, O. and Ugbogu, E.A., (2012).Phyto accumulation effects of amaranthus hybrid us L. ground on Buwvya refused dump site in chukum, Nigeria. Journal of Biodiversity and environmental science (JBES2), 10-7.

[2] ATSD R, (2009): Toxicological profile cadmium and Nickel. Atlanta Georgia U.S.

[3] Awenge, E.P, Karimah, M. and suhaimi, O. (2011): Heavy metals conceration of irrigation water, soils, furit and vegetables in Koto Bharu area, Malaysia. Journal at applied science in Environmental Sanitation 6 (4), 463-470.

[4] Awode, U.A., Uzairu, A. and Adelusi, S.U. (2008). Level of some trace metals in Fadama soil and peper, Nigena. Asian Journal of scientific research, 1 (4); 458-463.

[5] Benzarti, S., Mohri, S. R. and Ono, T., (2008). Plant response to heavy metals Toxicity. Environ Toxicology 23 (5) 607-614.

[6] Codex Alimenarus (2001). Maximum levels of cadmium in cereals, pulses, joint FAO/WHO standard, CAC/GL 39-2001.

[7] DAS, P., Smantary, S., Rout, G.R. (1997). Studies on cadmium toxicity in plant; Review environmental pollution 98 Pp 29-36.

[8] Dean, J.R (2013) Methods of environment trace analysis, John Wileg and Sons LTd, London. Pp 51-54.

[9] Demi’ rezen, D., Aksoy, A. (2006): Heavy metals level is reputable in Turkey are with in safe limit for Cu, Zn, Ni and acceding for Cd and Pb. Journal of food Quality.

[10] Farak, O., Nazin, S., Metinkara, S. (2006) Mentioning of cadmium and micronutrient in spices in Turkey. Journal of Agricultural Biology.

[11] FBN (2001): Dietary reference intake for vitamin A, vitamin K. arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium and zinc. Washington D.C, US, National academic press.

[12] Hutschison, T.C (1980). Effect of heavy metals pollution on plant. Vol 7 ed NW Applied since publishers, London. Lokesh wari, H and chandrappa,

[13] G.T (2006): Impact of heavy metals contamination of Bellaudur Lake in cultivates vegetation. Current science.

[14] Mohamed, A. R, Ahmed, K,S. (2006). Market basket survey for some heavy metals Egyptian fruits and vegetables. Food and chem. Toxicology 44:1273-1278.

[15] Muhammad, F., Anwar, F and Rashid, U (2008) Appraisal of heavy contents in different vegetables gran in vicenity.

[16] National food agency of Denmark (1995). Food monitoring (1988-1992)

[17] http/www.unece.orgistates/documents/cel(accessed December 2003)

[18] Sharma, R.K, Agrawal, M and Marshall, F.M (2008). Heavy melal (Zn, Cu, Pb) contamination of vegetables in urban India. Journal of environmental pollution series.

[19] Singh, M.A. and Kumar, M. (2006) Heavy metals load of soil water as vegetables in pair-urban Delhi environmental merit and assessment. 120:79-91.

[20] Tsafe A.,I, Hassan, L.G., Sahabi, D.M, and Bala, B.M (2012). Evaluation of heavy metal uptake and risk assessment of vegetables grown in yargalma of northern Nigeria. Journal of Basic and applied scientific research.

[21] Umar, Y.A.(2003) Problems of water scarcity and passible solution in Gombe metropolis , Gombe state.

[22] USEPA, (1996). Acid digestion of sediment sludge and soil: Method 305B (USEPA).

[23] Uwah, E. I. Ndahi, N. P. and Ogubuaja, V. D. (2011): Study of the level of some agricultural pollution in soil and water leaf. Nigeria, Journal of environmental chemistry and ecotoxicology 3 (10), 264- 271.

[24] Welgert, P. (1991). Metal loads of food of vegetables organic including mushrooms in metals and their compounds in the environment occurrence, Analysis and biological reference (ed. E. Marina) PP.458-68. Weinheim, VHC.

[25] Yahia. U.B.(2005) .The impact of Fadama development project on the dry season tarmers of gombe state, unpublished MSC, thesis

[26] Zhang, M.K.,He., Z,L, Stofella, P. J.Calvert., D.V.,Yang, E.X., Xia. Quality of phosphorous and heavy metals in potting media amaded with yard waste solids compos. Journal of environmental quality 33: 373-379.

[27] www.gometonigeria.com.www.onlinigeria.com\links\gomeadv.asp