Journal of Biological Sciences and Bioconservation
Volume 8, Number 1, 2016
ISSN: 2277-0143

EVALUATION OF SOME HEAVY METALS IN FRUITS

Baba Umar Abba Mustapha, Yakubu Baban Kanada, Goni Chamba, Babagana Mustapha & Abdullahi Muhammed

Department of Science Laboratory Technology, Ramat Polytechnic, Maiduguri, Borno State, Nigeria
Department of Science Laboratory Technology, Ramat Polytechnic, Maiduguri, Borno State, Nigeria
Nafdac Area Laboratory, Maiduguri, Borno State, Nigeria
Department of Science Laboratory Technology, Ramat Polytechnic, Maiduguri, Borno State, Nigeria
Department of Quantity Survey, Ramat Polytechnic, Maiduguri, Borno State, Nigeria
Email: babaumar144@yahoo.com

ABSTRACT

Exposure of heavy metals to human being has risen dramatically in the last 50 years. In today's urban and industrial society, there is no escaping from exposure to toxic chemicals and heavy metals. Humans are more likely to be exposed to heavy metal contamination from the dust that adheres to edible plants than from bioaccumulation. This is because it is very difficult to wash off all the dust particles from the plant material before ingesting them. The objectives of this experiment were to determine the concentration of heavy metals in some fruits. Based on the findings it was obtained from the elemental analysis of the fruits samples, iron, zinc, cadmium and lead each are having varying concentrations with considerable elemental value which confirmed the importance of these fruits. It was also confirmed that these fruits had great food and importance for human need as source of vitamin C, the fruits can be used in pharmaceutical industries for the production of medicine for treatment of many diseases such as heart disease. It was recommended that the fruits should be taken by human on daily basis, the cultivation and world production should be encouraged and further studies should be carried out of other fruits like pineapple, pawpaw and cashew fruits for heavy metals content.

Keywords: Heavy Metals, Fruits, Toxic Chemicals, Human Being.

INTRODUCTION

In botany a fruit is a part of flowering plant that drives from specific tissues of the flower, one or ovaries, and in some cases accessory tissues. Fruits are the means by which these plants disseminate seeds. Many of them that bear

edible fruits, in particular have propagated with the movement of humans and animals in a symbiotic relationship as a means for seed dispersal an nutrition respectively; in fact, humans and many animals have become dependent on fruit as a source of food. (Lewis, Robert A. 2002).

BOTANIC FRUIT AND CULINARY FRUIT

In the culinary sense of these words, a fruit is usually any sweet-tasting plant product, especially those associated with seed,' a vegetable is any savory or less sweet plant product: and a nut is any hard, oily, and shelled plant product. (These culinary vegetables that are botanically called fruit include cucurbits e.g squash pumpkin and cucumber). Tomatoes, peas, beans, corn, egg plant and sweet pepper. In addition some spices such as allspice and chilies, are fruits botanically speaking. (MCGee Harold. 2004). Botanically, a cereal grains such as corn, wheat or rice, is also a kind of fruit, termed as caryopsis. However the fruit wall is very thin, and is fused to the seed coat, so almost all of the edible grains are actually a seed. Many common terms for seeds and fruit do not correspond to the botanical classification in botany, seeds are ripened ovaries or carpels that contain the seeds and a nut is a type of fruit and not a seed. (MCGee 2004).

FRUIT STRUCTURE

The outer, often edible layer is pericarp formed from the ovary and surrounding the seeds, although in some species other tissues contribute to or for the edible portion. The pericarp may be described in three layers from outer to inner, the epicarp, mesocarp, and endocarp.

FRUIT DEVELOPMENT

A fruit result from maturation of one or more flowers, and the gynoecium of the flowers all or part of the fruits. Inside the overy/overies are one or more ovules where the megagametophyte contains the egg cell. After double fertilization, these ovules will become seeds. The ovules are fertilized in a process that starts with pollination, which involves the movement of pollen from the stamens to the stigma of flowers. After pollination, a tube grows from the pollen through the stigma into the ovary to the ovule and two sperm are transferred from the pollen to the megagametophyte, within the megagametophyte one of the two sperm unites with the egg, forming a zygote and the second sperm enters the central cell forming the endosperm mother cell, which complete double fertilization process. (Mauset, James D 2003). Later the zygote will give rise to the embryo of the seed, and the endosperm

mother cell will give rise to endosperm, a nutritive tissue used by the embryo. The ovules then develop into seeds, the ovary begins to ripen and the ovary wall pericarp may become fleshy (as in berries or drupes) or form a hard outer covering (as in nut). In some multi seeded fruits, the extent to which the flesh develops is proportional to the number of fertilized ovules. (Mauset, 2003).

MODES OF FRUIT DEVELOPMENT

There are three general modes of fruit development which are as follows:

1. Apocarpous fruit develop from a single flower one or more separate carpels and they are the simplest fruits.
2. Syncarpous fruit develop from a single gynoecium having two or carpels fused together.
3. Multiple fruit form from many different flowers.

Plant scientists have grouped fruits into three main groups which are as follows:

1. Simple fruits.
2. Aggregate fruits.
3. Composite or multiple fruit. (Singh Gurcharan, 2004).

The groupings are not evolutionarily relevant, since many diverse plant taxa may be in the same group, but reflect how the flower organs are arranged and how the fruit develop.

Simple Fruit

Simple fruit can be either dry or fleshy, are result from the ripening of a simple or compound ovary in a flower with only one pistil. Dry fruits may be either dehiscent (opening to discharge seeds), or indehiscent (no opening to discharge seeds). (Schlegel, 2003).

Aggregate Fruit

An aggregate fruit, or etaerio, develops from a single flower with numerous simple pistil (Schlegel, 2003).

Multiple Fruit

A multiple fruit is one formed from a cluster of flowers (called an inflorescence). Each flower produces a fruit, but these mature into a single mass. (Schlegel, 2003).

NUTRITIONAL VALUE

Fruit are generally high in fibre, water, vitamin c and sugar, although this latter varies widely from traces in lime, to 61% of the fresh weight of the date. Fruits also contain various phytochemicals that do not yet have an RDA/RDI listing under most nutritional fact sheets, and which research indicates are required for proper long-term cellular health and disease prevention regular consumption of fruits is associated with reduced risk of cancer, cardiovascular disease (especially coronary heart disease), stroke, Alzheimer disease, cataracts and some of the functional declines associated with aging. (Rui Hai Liu, 2003)

Cucumber

Scientific Classification

- Kingdom: Plantae
- unranked: Angiosperm
- unranked: Eudicots
- unranked: rosids
- order: cucurbitales
- family: cucurbitaceeae
- Genus: cucumis
- species: c. sativus.

Cucumber (cucumis sativus) is a widely cultivated plant in the gourd family cucurbitaceae. It is a creeping vine that bears cylindrical fruit that are used as culinary vegetables, but botanically they are termed as fruits. There are three main varieties of cucumber: slicing, pickling and burpless. Within these varieties, several different cultivars have emerged. The cucumber is originally from southern Asia, but now grows on most continents. Many different varieties are traded on the global market. (Nonnecke I.L 1989).

Tomato

Scientific Classification

- Kingdom: plantae
- unranked: angiosperm
- unranked: Eudicots
- unranked: Aserids
- order: solanales
- family: solanaceae
- genus: solanum
- spcies: slycopersicum

The tomato is the edible often red fruit /berry of night shade solanun lycopersicum, commonly known as tomato plant. The species originated in the south American Andes, and it is use as a food originated in Mexico, and spread throughout the world following Spanish colonization of the America's. It's many varieties are now widely grown, sometimes in greenhouse in cooler climates. The tomato is consumed in diverse ways, including raw, as an ingredient in many dishes, sauces, salad and drinks, while it is botanically fruit, it is considered as vegetable for culinary purposes. (As well as under U.S customs regulations) this has caused some confusion. The fruit is rich in lycopene, which may beneficial health effects. The tomato belongs to the family solanaceae. (Enza Zaden-Teeltnieuws 2009).

Watermelon

Scientific Classification

- kigdom: plantae
- unranked: angiosperm
- unranked: eudicots
- unranked: rosids
- Order: cucurbitales
- Family: cucurbitaceae
- Genus: citrullus
- Species: C. lanatus

Watermelon has a trinomial name which is (citrullus lanatus var. lanatus, family cucurbitaceae) is a vine like (scrambler and trailer) flowering plant originally from Southern Africa. Its fruit, which is also called watermelon, is a special kind referred by botanist as a pepo, a berry which has a thick rind (exocarp) and fleshy centre (mesocarp and endocarp) pepos are derived from an inferior ovary, and are characteristic of the cucurbitaceae. The watermelon fruit, loosely considered a type of melon although not in the genus cucurmis-has a smooth exterior rind (usually green with dark green stripes or yellow spots) and a juicy sweet inferior flesh (usually deep red to pink, but sometimes orange, yellow or white).wehner Todd C. 2006.

AIMS AND OBJECTIVES

The aim of this research work is to evaluate some heavy metals in some selected fruits available in Maiduguri, Borno state. The basic objectives are as follows:

1- To determine the concentration of some heavy metals such as; lead (Pb), zinc (Zn), cadmium (Cd), and iron (Fe) in fruits like watermelon, tomato and cucumber.
2- To compare the values obtained with the standard permissible values given by the WHO or any regulatory agency.
3- To draw possible conclusion and recommendation based on the relation of the study.

SIGNIFICANCE OF THE STUDY

The study when satisfactory conducted is expected to show the as it relates to the use of human needs.

SCOPE AND LIMITATION

The scope of this work is on three fruits sold in Maiduguri which are; watermelon, tomato, and cucumber and limited to evaluating some heavy metals such as: Pb, Zn, Cd, and Fe.

STATEMENT OF THE RESEARCH PROBLEM

Many heavy metals act as biological poisons even at part per billion (ppb). The heavy metals accumulated in organic matter in soils are taken up by the growing plants and the uncontrolled input of heavy metals in soil is undesirable because once accumulated into the soil. Subsequently may be the problem of toxicity to the plants growing on the contaminated soils, and uptake by the plants result in high metal levels in plant and this may ultimately affect the entire food chain. Some studies have also shown that there is a high prevalence of kidney problem which may raised eye brown, thus posing a serious health challenge to human especially children.

LITERATURE REVIEW

The effect of heavy metal combination of fruit cannot be under-estimated as these foods are important components of human diet. Fruits are rich source of vitamins, minerals and fibers also have beneficial antioxidative effects. However, the intake of heavy metal contaminated fruits may pose a risk to human health, hence the heavy metal contamination of food quality assurance. Heavy metals, generally are not biodegradable have long biological half-lives, and have the potential for accumulation in different body organs, leading to unwanted side effect plants take up heavy metals by absorbing them from air borne deposits on the parts of the plants exposed to the air from the polluted environments as well as from contaminated soils through root system. Also, the

heavy metals contamination of fruit may occur due to their irrigation with contaminated water (Al-Jassir et al, 2005).

Demerizen and Aksoy (2006) have investigated the concentration of some heavy metals in different vegetables grown in various parts of Turkey. The level of heavy metals (lead, cadmium, iron and zinc) have been examined in selected fruits and vegetables sold in local Egyptian markets (Demirzen and Aksoy, 2006). Fytianos et al. (2001) studied the content of heavy metals in vegetables grown in an industrial area of northern Greece. And (sobukola et al 2010) investigated the concentration of some heavy metals in fruits and leafy vegetables from selected market in Lagos, Nigeria.

Based on their persistence and cumulative behavior as well as the probability of potential toxicity effects, the absorbtion of heavy metals in human diets as a result of the consumption of vegetables and fruits means that there is a requirement for the analysis food items to ensure that the level of trace heavy metals meet the agreed international standard s. this is particularly important for farm product from part of the world where only limited data on the heavy metals content are available. The heavy metals are known as the element in their simple inorganic form. In nutrition they are commonly refered to as nutrient or inorganic nutrient, and these elements is divided into two depending on their amount needed by human's body system. There is micro and macro elements, the example of micro element s which is needed in small quantity are iron and zinc while the macro element which are needed in large quantity are calcium and magnesium. (Mc Gilvery, 2006). The important of such heavy metals is illustrated by the fact that there are over 50,000 enzymes in the body, contributing to the direct growth and energy and each enzymes has a particular element associated with it, each of these elements dose a specific job in the body and some of them do extra work if team to keep body cell healthy.

These elements are essential elements which are requiring by human body for proper growth and development, which in turn can be harmful when taking in large quantity in the body system.

THE TOXICITY OF HEAVY METALS IN FRUIT JUICE

Heavy metal occurs in all foods as natural or inherent components of plant and animal tissues and fluid and also may be present as a result of contamination or deliberate (Underwood 1973). One form of environmental contamination arises from exposure to water pollution by industries (Matthew, 1986). Although, many

heavy metals are essential for animal tissues metabolism the ranges between beneficial and toxic level are usually small. There is an increasing concern about the health effects in human due to continue consumption of fruit juice contaminated with heavy metals.

ENVIRONMENTAL AND HEALTH RISK OF HEAVY METALS

The effect of heavy metals impair our nervous system, our immunity, digestion, mental health, hormones and even our bones, muscles and reflexes. This shows procedures base on simple natural ingredient in safe to do 2-3 days, week, or once a month depending on the severity of symptoms. It makes one feel very energetic and help to normalize thyroid hormones so it is easier to lose weight. Heavy metals are dangerous because they lead to bioaccumulation. Bioaccumulation means an increase in the concentration of a chemical in a biological organism over time compared to the chemical concentration in the environment. Compounds accumulate in living thing anytime there are taking up and stored fasted, than they are broken down metabolisms or excreted.

FUNCTION OF HEAVY METALS IN MAN

The interactions of these micro and macro nutrient are difficult to study. Since they are found occurring in various forms in fruit and in diet we eat in different proportion. There absorption from the intestinal tract may be different depending on the relative concentration might be synergetic or antagonistic; the amount could depend on the amount of the essential element present in our fruit and diet (Combs, 1988).

Zinc

The physiological importance of zinc is that, it is a component of several enzymes which catalyse vital metabolic reaction. Zinc is an integral part of the molecule of carbonic antrydrase (found in red blood cell). Zinc is peptridase and of several detrygrogenases active in the liver of animals and by inference possibly in man as well. It is necessary for healthy immunity system and is also in fighting skin problem such as acne, boils and sore throats. It is further needed for cell division and it is also needed by the tissue of the hair, nails and skin to be in top form. Zinc is further used in the growth and maintenance of muscles. (Thompson, 1988).

Iron

Although its amount in the body is also small (about 60 to 70 neonates). The fact that it is essential constituent of haenoglobin and cytochrome and other compound of respiratory enzymes system. Its chief function lies in transport of oxygen to the tissue (haenoglobin) and in cellular oxidation mechanism (cytochrome system).

Cadmium

Foodstuffs that are rich in cadmium can greatly increase the cadmium concentration in human bodies. Examples are, liver, mushrooms, shellfish, mussels, cocoa powder and dry seaweed and exposure to significantly higher cadmium levels occur when people smoke. Tobacco smoke transport cadmium into the lungs. Blood will transport it through the rest of the body where it can increase effect by potentiating cadmium that is already present from cadmium rich food.

Lead

Lead is a useful and common metal that has been used by humans for thousand years. It is also very dangerous poison, particularly for children, when it is accidentally inhale or injected. Rule and regulation prohibit lead in common product like gasoline and paint, so lead poison has drastically decline in the United States. Lead is found frequently in our environment. It has no known purpose in our bodies. When lead gets inside the body, the body confuses it with calcium and other essential nutrients. This confusion can cause permanent damage to the health of both children and adults.

SOURCES OF HEAVY METALS IN FRUIT

Anthropogenic source of metals, mine, smelling and other various industrial and agricultural activities. When these elements are deposited on the soil fruit plant absorbs these elements from the soil through their roots as micro and macro nutrient which are essentially for their growth and development. The fact that fruits plant absorbs heavy metals from the soil made ancient Greeks to call it soil eaters. (Sylvia 1985). The following heavy metals such as Fe, Zn, Cd, and Pb when are leached into the soil the fruit plant absorb these heavy metals and are transported to the branches of these fruit plant then to the fruit which are finally taken and when these fruit are processed into fruit juice.

BENEFIT EFFECT OF HEAVY METALS

Heavy metals like Fe, Pb, Cd, and Zn are very important in small amount while others required in a large amount in the nutritional point of view. They are needed by both plant and human being for their proper growth and developments, while deficiency of such heavy metals may cause various deformities ranging from loss of hair, loss of weight and loss of interest in sex in the cases of iron (Fe). Human being and other animals get some of those elements from fruits. Heavy metals are essential to human being in low concentration while others in high concentration as they are main component of biological catalys called enzymes (Berill 1996). They help the body to produce substance which are important for proper metabolic activities such as hormones and vitamin A, which is essential for the formation of red blood cells. Iron (Fe) is essential in distributing the oxygen inhaled into the lungs to all cells. It's the master minerals elements which creates vitality and stamina, while calcium is useful in the formation of strong bone and teeth (Berill 1996).

The presence of these heavy metals in fruit has placed a high demand of fruit juice worldwide. Iron (Fe) and calcium (Ca) which are gotten from varieties of fruit s have become the most important in the global health terms. Their deficiency represents a major threat to health and the development of the population worldwide particularly children and pregnant women in the developed countries(Wenlock,etal 1979).

DEFICIENCY AND HARMFUL EFFECTS OF METALS

Heavy metals at higher concentration are toxic to the body and can cause various degrees of injury to the body system ranging from possible carcinogenic and mutagenic effect to even the death of human being. For example, Zinc at high concentration cause fatigue, dizziness and neutogena (Hess etal 2002), while the deficiency of heavy metals ranges from the severe blood loss nutritional anaemia and low resistance to disease for iron (Fe). Zinc at low concentration cause a loss of normal rest, skin disease, loss of hair, poor appetite and diarrgoea.

METHODOLOGY

Materials and Reagent

Materials/Apparatus

- Spoon
- Smart spectrometer
- Measuring cylinder

- Pipette
- Syringe
- Filter paper
- Blender machine

Reagents

- Distilled water
- Ammonium chloride
- Sodium cyanide
- PAR indicator
- Stabilizing agent
- DDC reagent
- Buffer ammonia reagent
- Sodium citrate
- PAN indicator
- Iron reagent
- Methyl alcohol
- Zinc buffer
- Formaldehyde solution
- Sodium ascorbate
- Dilute zinc indicator

Sample Collection

The sample of tomato, cucumber, and watermelon were purchased at Baga Market Borno state.

Sample Preparation

Small portion of the outer and innerpart of the sample were dried for 24 hours. After the sample has completely losses its moisture content, it was grinded using blender machine. Then the powdered sample was dissolved in 100ml of distilled water. The solution was left for 24 hours and then filtered using filtered paper; 10ml of the filtered solution was weighed accurately into test tube.

Principle of Spectrophotometer

When the spectrophotometer is put on, the lamp will produce a ray which will pass through glass slit to glass filter; some ray will pass while some will deflect back. Some will pass through the cubette hole where the solution is being inserted, the amount of the ray that passes through is depend on the

concentration of the solution to the photocell where it will convert into electric energy and finally to the galvanometer which display the result on the screen. This is principle of spectrophotometer (victor, 2000).

Determination of Iron

A universal sample tube was rinsed with distilled water and filled with 10ml line. It was inserted into the sample chamber and scan blanked at iron test menu, sample was removed and 0.5ml of iron reagent was added to the sample using 0.5 ml pipette. The sample was capped mix; a 0.1g iron reagent 2 powdered was added. Sample was capped and swirled then shook vigorously for 30sec. wait 3mins, for maximum colour development, sample was immediately inserted into the chamber and scanned. This result was recorded in ppm.

Determination of Zinc

A universal sample tube was rinsed with distilled water and filled with 10ml. It was inserted the sample chamber and scan blanked at zinc menu. The sample was removed from the chamber and a 0.5g sodium ascorbate powder was added to the sample using 0.5g spoon. The sample was capped and shook vigorously then 3 drops of 10% sodium cyanide was added. The sample tube was capped and swirled. 1ml of dilute zinc indicator solution was also added using a 1ml pipette the sample tube was capped and mix again. A plain pipette was used to add 4 drops of 37% formaldehyde solution, the sample was capped and inverted 15 times then it was inserted into the sample chamber and scanned, the result was recorded in ppm.

Determination of Lead

A universal sample tube was rinsed with distilled water and filled with 10ml line. It was inserted into the sample chamber and scanned blanked at lead menu. 5ml of sample was removed using a syringe and was discarded, 5ml of the sample in the tube was transferred into the tube. A 5ml of buffered ammonium chloride was added to fill the 10ml line of the tube; the sample was swirled to mix. 3 drop of 10% sodium cyanide was added. Sample was swirled to mix. A 0.5ml pipette was used to add 0.5ml PAR indicator then swirled again. Another 0.5ml pipette was used to add 0.5ml stabilizing reagent. The sample was capped and mix then inserted into the sample chamber and scanned and the result was recorded as reading A. The sample was removed from the sample chamber, 3 drops of DDC reagent was added. The sample was capped and swirled then subjected for analysis. The result was recorded as reading B.

ppm lead = reading A- reading B.

Determination of Cadmium

A universal sample tube was rinsed with distilled water and filled with 10ml line. It was inserted into the sample chamber and scanned blank at cadmium menu. The sample was removed from the sample chamber and a 1.0ml buffered ammonia reagent was added using 1.0ml pipette. The sample tube was capped and swirled to mix; a 3 drops sodium citrate (10%) was added. Sample was capped and swirled to mix again, add 0.5ml PAN indicator using 0.5ml pipette and swirled again to mix. Add 0.5ml stabilizing reagent cap and mix. Sample was immediately inserted into the chamber and scanned. The result is recorded in ppm.

RESULT AND DISCUSSION

The results obtained from the analysis carried out to determine the concentration of various metals are presented in the table below. The concentration in part per million (ppm) were observed in some elements to be higher than the others in the samples.

Table 4.1: **THE CONCENTRATION OF HEAVY METALS IN FRUITS MEASURED IN (PPM).**

Heavy Metals	Sample 1 (ppm)	Sample 2 (ppm)	Sample 3 (ppm)	Standard Values (ppm)
Fe	4.33	5.73	4.75	1.6 - 6.40
Zn	0.44	0.53	0.75	10 - 15.00
Cd	3.30	2.20	3.50	6.7 - 8.30
Pb	N.D	N.D	0.10	0.05 - 3.00

Key: Sample 1 = Tomato
Sample 2 = Watermelon
Sample 3 = Cucumber.

DISCUSSION

The table above presents the various concentrations of elements in different fruits samples. It could be seen that some are low and others are high in concentration compared to daily dietary intake (WHO) recommended value.

From the table above, this analysis showed that the concentrations of iron are 4.33, 5.73 and 4.75 respectively in all the three samples. And the recommended daily dietary intake of iron is 1.6 – 6.4ppm which shows that all the samples are within the safe limit of WHO. According to Berrill 1996, iron helps the body to

produce substances which are important for proper metabolic activities such as hormones and vitamin A, which is essential for the formation of red blood cells. Iron is essential in distributing the oxygen inhaled into the lungs to allcells. It is the master mineral elements which creates vitality and stamina. But zinc concentration in all the samples are found to be low as compare to the daily intake of WHO which is 10 – 15ppm through recommended value is suggested to a very mild amount and therefore not toxic, since it has no essential or beneficial effect on tissue. And also it could be seen that in both sample iron is having the highest concentration followed by cadmium. The concentrations of cadmium are 3.30, 2.20, and 3.50ppm. And the recommended daily dietary intake of cadmium is 6.7-8.3ppm, which shows that all the sample are within the safe limit of WHO, while lead (pb) could not be detected in some of the samples but present in cucumber which is 0.10 and it is found to be low as compare to the daily intake (WHO), which is 0.05 – 3.00ppm.

In conclusion, the concentration of the determined heavy metal Fe, Zn, Cd and Pb for the three samples under study with least concentration not health threaten. Which presented value below WHO standard.

CONCLUSION

Base on the data obtained from the elemental analysis of the fruit samples. Iron, zinc, cadmium, and lead each having varying concentrations with considerable elemental value which confirmed the importance of these fruits. It was also confirmed that, these fruits have great food and importance for human need as a source of (vitamin C).

These fruits have considerable amount of these elements that are essential to human, animals and plants. It can also be used in pharmaceutical industries for the production of medicine for the treatment of many disease e.g heart disease and it can be used also in the brewery for production of drinks like fruit juice and jelly e.t.c.

Finally, having examined the result for this research work, these fruit are recommended to be taking daily because they contain some appreciable amount of vitamin C. So when eaten in appropriate quantity, they can add appreciable amount to be required daily allowance (RDA) of vitamin C intake.

RECOMMENDATIONS

Having been able to confirmed the importance and useful of fruit as it is employ in a great variety of ways, in drinks like fruit juice, butter cookies. I wish to put forward the following recommendations:

1- The cultivation and world production of these fruits should be encouraged.
2- 2- Because of the nutritive value and content of the analysed fruits, they should eat regularly and on daily basis as part of it reduces the risk heart disease.
3- 3- People should also appreciate the various sourse of ascorbic acid particularly in fresh fruits so as to avoid deficiency of vitamin C to enable people use these fruits available to them as source of vitamin C.

4- 4- Further studies should carry out of other fruit like pineapple, pawpaw and cashew fruits e.t.c. for heavy metals content.

REFERENCES

Al-Jassir, M. S. Shaker, *A. and Khalid, M. A. (2005).* Deposition of Heavy Metals on Green Leafy Vegetables Sold on Road Side of Riyadh City, Saudi Arabia, Bulletin of Environmental Contamination and Toxicology Vol. 75, No. 5 P. 1020-1025.

Berril, N. J. (1996). Biology in Action P. 27-28.

Combs G. F. (1988). Advance in Food Research P. 32, 85-113.

Enza Zaden-Teeltnieuws. Het Gemiddelde Vruchtgewict Van Ingar Light Tussen 100- 110 Gram. (2009) Enza Zaden.nl.

Hess, R. and Schmid, B. (2002). Zinc Supplement Over Close Can Have Toxic Effect. *Journal of Haemtal Onco.* P. 582-584.

Lewis, Robert A. (2002). CRC Dictionary of Agricultural Science. CRC Press. ISBN 0-8493-2327-4.

Mauseth (2003). Botany. Chapter 9: Flowers and Reproduction ISBN 978-0-7637- 2134-3

Mauseth James D. (2003). Botany: An Introduction to Plant Biology. Boston: Jones and Bartlett Publishers. P. 258 ISBN 978-0-7637-2134-3.

MCGee, (2004). On Food and Cooking P.367. ISBN 978-0-684-80001-1.

MC Gilvery, R. C. (2006). Determination of the Level of Mineral Elements in Fruits *Journal of Food Commodity Science,* Vol. 37, Issues 5 P.15 and 56.

Mc Gee Harold (2004). On Food and Cooking: The Science and Lore of the Kitchen. Simon and Schuster. P. 247-248 ISBN 0-684-80001-2.

Rui Hai Liu (2003). Health Benefits of Fruits and Vegetables are Form Additive and Synergistit Combination of Phytochemicals. Liu 78 (3): 5175-American *Journal of Clinical Nutrition.* Ajcn.org.retrieved (2014).

Schlegel (2003). Encyclopedia Dictionary. P. 123. ISBN 978-1-56022-950-6.

Schlegel, Rolf H. J. (2003). Encyclopedia Dictionary of Plant Breeding and Related Subjects Haworth Press. P. 177. ISBN 1-56-022-950-0.

Singh Gurcharan (2004). Plant Systematic: An Integrated Approach. Science Publishers. P. 83. ISBN 1-57808-351-6.

Sylvia, S. (1995). Text Book of Biology P. 665-667.

Victor O. Ogugbuja (2000). Absorbtion Emission Spectroscopy. An instrumental Methodology in Analytical Chemistry, Published by FAB Anieh Nigeria Ltd P. 133-142.

Wehner, Todd C. (2006). Watermelon Crop Information North Carolina State University.

Reference to this paper should be made as follows: Baba Umar Abba Mustapha *et al*, (2016), Evaluation of Some Heavy Metals in Fruits. *J. of Biological Science and Bioconservation,* Vol. 8, No. 1, Pp. 57-72