Parasitic Contamination Of Fruits And Vegetables Sold At Akure Metropolis, Ondo State, Nigeria.

* Simon-Oke, I.A, Afolabi O.J Obasola O.P.

Department Of Biology, Federal University Of Technology Akure Nigeria.
Adepejuolayemi@Yahoo.Com

Abstract: The parasitic contamination of fruits and vegetables sold for consumption in Akure metropolis was assessed with respect to their contamination by ova and cysts of parasites. Microscopic examinations of the samples were carried out using standard Floatation techniques by (Cheesebrough, 2003). A total of six hundred (600) samples of fruits and vegetables were examined with five (5) varieties each, from four (4) different markets at Akure metropolis. High levels of contamination were recorded in both fruits (92.5%) and vegetables (76.5%) examined. The highest rate of contamination (22.5%) was recorded in African spinach (*Amaranthus hybridus)* while Jute mallow (*Corchurus olitorious*) was the least contaminated (12.5%). For fruits, Tomato (*Lycoperisicon esculentum*) was the most contaminated (37.5%) while the least contamination (5%) was recorded in Mango (*Mangifera indica*). The Protozoans and Helminths identified were *Ascaris lumbricoides, Balantidium coli, Entamoeba histolytica, Giardia lamblia, Hymenolepis nana* and *Ancylostoma duodenale*. The most prevalent parasite encountered was *A. lumbricoides* (25.7%) while *A. duodenale* (8.5%) was the least parasite found. The study indicated high rate of protozoan and helminthes contamination of fruits and vegetables in the study area. The implications of the findings were discussed and preventive measures proffered.
[Simon-Oke I.A, Afolabi O.J, Obasola O.P. **Parasitic Contamination of Fruits and Vegetables sold at Akure Metropolis, Ondo State, Nigeria.** *Researcher* 2014;6(12):30-35]. (ISSN: 1553-9865). http://www.sciencepub.net/researcher. 5

Keywords: Fruits, Vegetables, Contamination, Helminths, Protozoans, Zoonotic, Cysts.

1. Introduction

Vegetables and Fruits are essential for good health and they form a major component of human diet. They are vital energy contributors that are depended upon by all levels of human as food supplement or nutrients. They have high water content as seen in water leaf, lettuce and cabbage. Many vegetables and fruits are good sources of vitamin C, Carotene and Mineral elements such as iron (Duckworth, 1996). Regular consumption of fruits is associated with reduced risks of cancers, cardiovascular diseases (especially coronary heart disease), stroke, cataracts and some of the functional declines associated with aging (American journal of Clinical nutrition, 2012). Diets that include a sufficient amount of Potassium from fruits and vegetables also help to reduce the chance of developing kidney stones and the effect of bone loss.

Fruits are generally rich sources of fibres and carbohydrates. They are very healthy, whole to be enjoyed in moderation because some fruits are high in calories, carbs and glycomic index. An important nutritional value of fruits is its antioxidant contents, fruits such as orange, carrot, garden egg and tomato have the highest antioxidant value (Halvorsen *et al*., 2002). Antioxidant neutralizes free radicals which are harmful molecules that damage the body cells and cause inflammation. They are commonly measured as Oxygen Radical Absorbance Capacity (ORAC) (Aprikian *et al*., 2003).

The nutritional content of vegetables varies considerably. Generally they contain little protein and fat, dietary minerals, Carbohydrate and varying proportion of vitamins such as Vitamin A, vitamin K and vitamin B_6. Vegetables contain a great variety of other phytochemicals some of which have been claimed to have antioxidant, antibacterial, antiviral and carcinogenic properties (Gruda, 2005).

Intestinal parasitic diseases are still a public health problem in the developing countries, probably due to poor sanitation and inadequate personal hygiene (Steketee, 2003; Kang, 1998). About one third of the world, are infected with parasites (CDC, 2001).In Africa, the transmission of intestinal parasitic infection has been considered to increase due to the frequent use of untreated human or animal dung as manure in cultivation by local farmers, which serve as a source of enchantment of zoonotic parasitic infection (Luca *et al*., 2000). Consumption of raw or un-hygienically prepared vegetables such as water leaf (*Talinum triangulare*), cabbage (*Brassica deracea*), tomato (*Lycopersicon esculentum*), Carrot (*Daurus carota*) e.t.c is considered to be risk factor for human parasitic infections (Chessbrough, 1991).

The cultivation of vegetables and fruits for commercial and domestic purposes in Nigeria is mostly carried out by peasant farmers who depend on irrigation and/ or natural rainfall (Luca, 2000). Most farmers use untreated animal and human faeces as manure, which are known to contain various species of

parasites that are of medical and veterinary importance (Okoronkwo, 1998). Indiscriminate faecal disposition in bushes, farmlands and even in cultivated farms with a belief of enriching the land is also a common practice by some farmers. Some of the water bodies used for irrigation are also polluted with parasites infected excreta that could lead to recycling of infection (Al-shaa and Mwafy, 2007).

In recent years, there has been an increase in the number of reported cases of food borne illness linked to consuming fresh fruits and vegetables. The consumption of raw vegetables plays a major epidemiological role in the transmission of parasitic food borne diseases (Abougrain *et al*., 2010). Since vegetables require a moist environment for growth, these conditions favour the development of transmissible form of enteroparasites such as cysts and eggs (Oliverra and Germano, 1992). Many outbreaks of Protozoan infections in humans have been linked to raw fruits and vegetables. Previous studies have revealed that many types of vegetables and fruits purchased at markets in different regions from many developing countries were contaminated with Helminthes eggs as well as protozoan oocysts (Anuar and Ramachan, 1977; Alshaa and Mwafy, 2007).

Vegetables and fruits particularly those eaten raw and without peeling can be agent of transmission of protozoa and helminthes (Porter *et al,* 1990). Vegetables and Fruits normally becomes a potential source of human parasitic infection by contamination during production, harvesting, collection, transport and preparation or processing. According to many studies, there was a strong association between vegetables and fruits especially the raw ones and parasitic infection (Cheesebrough, 1991; Roberts, 2001).

However, Altekruse (1997) reported that the potential risks factors for human intestinal parasitic infections are *Ascaris lumbricoides, Trichuris trichuria, Ancylostoma duodenale, Necator americanus, Balantidium coli, Giardia intestinalis and Blastocystic hominis* which are involved in unhygienic associations with unhygienic environments. Several surveys in different parts of the world showed that vegetables can be agent for transmission of protozoan cysts and oocysts such as *Giardia, Entamoeba, Cyclospora, Toxoplasma,* and helminthes eggs and larvae of *Hymenolepis, Taenia, Fasciola, Ascaris, Strongyloides* and Hookworms (Vuong, 2007; Oliveirra and Germano, 1992).

Considering the important role of fruits and vegetables, there is need for routine investigation or surveillance programme to be conducted from time to time to check the presence of parasites on fruits and vegetables consumed by the populace. The main objective of the present study was to determine the parasitological contamination of fresh vegetables and fruits sold in markets at Akure metropolis.

2. Materials and Methods

2.1. Study Area and Sampling sites

The study area was Akure metropolis which is the capital of Ondo State, a moderately populated city, located in South-western region of Nigeria on Longitude 5^o 21E' and Latitude 7^o 24N'. The sampling sites comprised of four major markets in Akure metropolis. The markets were: Oba central market, Isinkan, Iloro and Isolo. These markets always have fresh produce from the farms.

2.2. Sample Collection

This study was carried out between February and May 2013. Five different types of vegetables and fruits that are frequently consumed in Akure city were sampled for intestinal parasites. Fruits that were screened for the presence of parasites were Tomato (*Lycoperisicon esculentum*), Garden egg (*Solanum aethiopicum*), Orange (*Citrus sinensis*), Carrot (*Daurus carota*) and Mango (*Mangifera indica*). The vegetables were African spinach (*Amanranthus hybridus)*, Jute mallow (*Corchurus olitorious*), Fluted pumpkin (*Telfaria occidental*), *Senecio biafrae* and Water leaf (*Talinum triangulare*). They were purchased very early in the morning at the time the traders were arriving from the different supplying farms. The items were picked randomly from the four markets in order to obtain qualitative estimation of parasitic contamination of the samples.

2.3. Macroscopic Examination of Samples

The samples were examined carefully for the presence of macroparasites such as Cestodes and adult Nematodes with naked eyes.

2.4. Microscopic Examination of Samples-Floatation Technique

The zinc sulphate floatation technique was used for concentrating the cysts and ova of the parasites. The samples were weighed and washed in distilled water. The washings were centrifuged at 250rpm for one minute and the supernatant was decanted. 2ml of the sediment was placed in a15ml test tube which was filled with zinc sulphate solution to the brim and a cover slip was placed on top. The cover slip was removed after twenty (20) minutes to allow enough time for the cysts and ova to float. The cover slip was placed face downwards on a slide and was examined under x10 and x40 objectives with a drop of iodine under the cover glass, to identify the cysts (Cheesebrough, 2003; Neva and Brown, 1983).

2.5. Statistical analysis of the Data

The distribution of parasites by the study area was analysed by computing Analysis of Variance (ANOVA) on the data collected. Also, the Null Hypothesis was tested to find whether there was no

significant difference between the distribution of parasitic ova and cysts by the fruits and vegetables among the study areas at Cl of 5% (Erwin, 1970; Dauda et al, 2011).

3. Results

A total of six hundred (600) samples which comprised of two hundred (200) fruits and four hundred (400) vegetables were examined in this study. Ninety eight (98) sampled which represents 16.33% were positive for various parasites, out of which contaminated fruits and vegetables were 37(92.5%) and 61(76.25%) respectively. Fruits were more contaminated than vegetables (P<0.05) (Table 1). A total of 35 parasitic ova, larvae and cysts were encountered. The parasites were *Ascaris lumbricoides, Balantidium coli, Entamoeba histolytica, Giardia lamblia, Hymenolepis nana* and *Ancylostoma duodenale*.

Table 2 shows that, Tomato had the highest number of parasite contamination (37.5%) while Garden egg and Mango had the lowest number of parasite contamination (5%) respectively, out of the two hundred fruits sampled. Analysis showed that there is significant difference between the infected and uninfected fruits (P<0.05).

Out of the 400 sampled vegetables, African spinach recorded the highest number of parasite contamination (22.5%), while the lowest parasite contamination was found in Jute mallow (12.5%). There is no significant difference between infected and uninfected vegetables (P>0.05) (Table 3).

The most frequently encountered parasitic egg/cyst was *A. lumbricoides* (25.7%), followed by *B. coli* (22.8%), *E. histolytica* (20.0%) and the least occurrence was *A. duodenale* (8.5%) as shown on Table 4.

The most contaminated market sources for fruits were Oba, Iloro and Isinkan (30.0%) respectively. Analysis showed a significant difference between the markets. For vegetables, the most contaminated market source was Oba market (40.0%) while the least contaminated market source was Isinkan (10.0%) as shown on Tables 5 and 6.

The distribution of different species of parasite on fruits and vegetable is shown in Table 7. The most contaminated was Carrot which harboured the highest number of parasites (4), followed by Tomato (3), Oranges, Garden egg and Mango (1) respectively. In vegetables, African spinach harboured the highest number of parasites (7), followed by Fluted pumpkin (6) while Jute mallow harboured the least number (3).

One way Analysis of Variance (ANOVA) to test if there is no significant difference in the distribution of parasitic ova and cysts in the fruits and vegetables in the study area, showed that calculated value (0.533) was greater than P value (0.05) therefore, a significant difference existed in terms of parasite distribution at the study area, thus the Null hypothesis was rejected.

Table 1: Parasite contamination of fruits and vegetables in the study area

Item	Number Examined	Number Infected	Percentage Infected
Fruits	200	37	92.60*
Vegetables	400	61	76.25
Total	600	98	16.33

*=P<0.05 (significant) as compared with vegetables

Table 2: Distribution of parasite on fruits in the study area

Fruits	Number Examined	Number Infected	Percentage Infected
Tomato	40	15	37.5*
Orange	40	8	20.0
Carrot	40	10	25.0
Garden egg	40	2	5.0
Mango	40	2	5.0
Total	200	37	92.5

*=P<0.05 (significant) as compared with other fruits

Table 3: Distribution of parasite on vegetables in the study area

Vegetables	Number Examined	Number Infected	Percentage Infected
African spinach	80	18	22.5*
Fluted pumpkin	80	16	20.0
Jute mallow	80	10	12.5
Senecio biafrae	80	12	21.25
Water leaf	80	15	18.75
Total	400	37	76.25

*= P>0.05 (not significant) as compared with other vegetables

Table 4: Frequency (%) of occurrence of parasites in fruits and vegetables studied

Parasitic ova/cyst	**Number present**	**Percentage (%)**
Ascaris lumbricoides	9	25.7
Balantidium coli	8	22.8
Entamoeba histolytica	7	20.0
Giardia lamblia	4	11.4
Hymenolepis nana	4	11.4
Ancylostoma duodenale	3	8.5
Total	35	9.8

Table 5: Prevalence of parasite ova and cysts in relation to Vegetables sold at different sampling markets in Akure metropolis.

	Isolo		Oba		Iloro		Isinkan	
Vegetables	No.Examined	No positive	No Examined	No Positive	No Examined	No positive	No Examined	No positive
African spinach	20	5	20	1	20	10	20	5
Jute mallow	20	1	20	10	20	5	20	0
Fluted pumpkin	20	5	20	10	20	10	20	0
Senecio biafrae	20	1	20	10	20	5	20	5
Water leaf	20	5	20	1	20	5	20	0
Total	100	13	100	41	100	35	100	10

Table 6: Prevalence of parasite ova and cysts in relation to Fruits sold at different sampling markets at Akure metropolis.

	Isolo		Oba		Iloro		Isinkan	
Fruits	No. Examined	No positive	No Examined	No Positive	No Examined	No positive	No Examined	No positive
Tomato	10	0	10	0	10	10	10	0
Orange	10	0	10	10	10	0	10	10
Garden egg	10	0	10	0	10	0	10	0
Carrot	10	0	10	0	10	2	10	3
Mango	10	10	10	2	10	0	10	0
Total	50	10	50	12	50	12	50	13

Table 7: Distribution of different species of parasites on fruits and vegetables in the study area.

Fruits/ Vegetables	*Ascaris lumbricoides*	*Balantidium coli*	*Ancylostoma duodenale*	*Hymenolepis nana*	*Entamoeba histolytica*	*Giardia lamblia*	Total
Tomato	1	-	1	1	-	-	3
Orange	1	-	-	-	-	-	1
Carrot	2	1	1	-	-	-	4
Garden egg	-	1	-	-	-	-	1
Mango	-	1	-	-	-	-	1
African spinach	1	1	-	2	3	-	7
Jute mallow	1	1	-	1	-	-	3
Fluted pumpkin	-	-	-	-	2	3	6
Senscio biafrae	2	3	-	-	1	-	5
Water leaf	1	-	1	-	1	1	4
Total	9	8	3	4	7	4	35

4. Discussion

The recovery of protozoan and helminthes ova and cysts from fruits and vegetables is of great public health significance. This is because some of the fruits and vegetables may be eaten raw, in addition people often pick up fallen fruits and eat after merely dusting off the visible dirt with their hands or clothing. This study reported high prevalence rate of parasitic contamination of both fruits and vegetables.

Infestation of fruits and vegetables with human pathogenic species of parasite as recorded in this study revealed that out of six hundred samples of five varieties of fruits and vegetables examined, 98(16.33%) of the samples were contaminated. This result is similar to the findings of Umaeche, (1991) who screened fruits sold in Calabar for parasites. The work of Umoh *et al*,(2001) and Dauda *et al*, (2011) corroborated this result where they recorded 13.5% and 14% positive cases of parasites on fruits and vegetables sold at Kaduna and Zaria respectively. However, the works of Damen *et al,* (2007) and Leon (1992) disagreed with this result where they both

reported 36.0% and 54.3% cases of parasitic contamination of fresh vegetables in Jos, Nigeria and Manila, Philippines. The observed differences might be connected to the environmental differences in which the vegetables and fruits were cultivated and also may be due to poor handling of vegetables and fruits by farmers and at the point of sales.

With respect to the prevalence of parasitic ova, cysts and larvae infestation of vegetables and fruits in the study area, African spinach had the highest percentage contamination of 18(22.5%) and the least contamination was found in Jute mallow 10(12.5%) Table 3. This may be due to the rough surface and leaf folds of this vegetable which may retain dirt that cannot be easily washed off at the point of harvesting. This work disagreed with the works of Ohaeri *et al,* (2011) and Dauda *et al*, (2011) where Water leaf was the most contaminated vegetable.

Among the fruit varieties, Tomato was the most contaminated which could be as a result of its low growth height above the soil level that predisposed it to contamination with parasites during flooding as well as heavy rain splashes. More so, Tomato grows in uncultivated soil frequently in poor environment where sewage and other human effluents are deposited. However, this result disagreed with the work of Dauda *et al,* (2011) in which Tomato and Carrot had 10% and 6% contamination rates respectively.

The most frequent parasitic ova, larva and cysts encountered among the ninety eight positive samples were A. lumbricoides 9(25.7%), B. coli 8(22.8%), E. histolytica 7(20.0%), G. lamblia and H. nana 4(11.4%) respectively and A. duodenale 3(8.5%) Table 6. The highest prevalence was found in A. lumbricoides which may be as a result of their viability of the eggs in the soil for months and being the commonest parasite in the tropics (Stephenson, (1987). This result corroborated the work of Ohaeri *et al*, (2011) where he reported that A. lumbricoides (80.6%) was the most prevalent helminth observed on fruits and vegetables in Umuahia, Abia State. Also the result is in line with the work of Dauda *et al*, (2011) where he reported 24.00% for A. lumbricoides. Shuval *et al*, (1984) also reported that people consuming vegetables irrigated with raw waste water are exposed to the risk of infection with Ascaris lumbricoides, Entamoeba histolytica and Giardia lamblia.

Infection of fruits in different markets show that Oba, Isinkan and Iloro markets had the highest percentages (30.0%) while the least (10.0%) infected fruits were found at Isolo market. The highest number (40.0%) of infected vegetables was found at Oba market while the least contaminated vegetables were found at Isinkan market. The differences in the rate of contamination of fruits and vegetables among the four sampled markets could be attributed to the source(s) o water used for irrigation. Also the poor and filthy environment including the concentration of refuse heaps constitute means of contamination for these produce even at the point of sale where these edible products are displayed, since flies can mechanically transfer cysts and ova of parasites to these fruits and vegetables.

5. Conclusion

The study has revealed the potential risk of contacting intestinal parasite infections through ingestion of locally grown unwashed fruits and vegetables. Reduction of the risk of human of intestinal parasite associated with raw fruits and vegetables can be better achieved through control of faecal pollution in the farms, during harvesting, distribution or in retail markets or in the homes. Although advances in farming and horticultural practices, processing and distribution have generally enabled raw vegetable industry to supply high quality produce to consumers all year round, some practices have resulted in an expansion of the geographical distribution and incidence of human illness associated with an increasing number of pathogenic bacterial, viral and parasitic micro organisms.

Corresponding Author's Address:
Simon-Oke Iyabo Adepeju
Department of Biology, School of Sciences,
Federal university of Technology Akure,
P.M.B 704 Akure, Nigeria
E-mail: adepejuolayemi@yahoo.com

References

1. Duckworth R. Farming systems for the production of fruits and vegetables. Oxford: Pergama press 1996; 48-62.
2. America Journal of Clinical Nutrition. *The American Society for Nutrition* 2012; 0002-9165.
3. Halvosen B, Myhrstad M, Barikmo I, Hvattum E, Remberg S, Wold A, Haffnern K, Baugerod H, Andersen L, Moskaug J, Jacobs D, Blohoff R. Asystematic screening of total antioxidants in dietary plants. *Journal of Nutrition 2002;* 132(3): 461-471.
4. Aprikian O, Duclos V, Besson C, Manach C, Benalier A, Morand C, Remesy C, Deminge C. Apple pectin and polyphenol- rich apple concentrate are more effective than separate cecal fermentations and plasma lipids in rats. *Journal of Nutrition* 2003; 133(6):1860-1865.
5. Gruda N. Impact of Environmental Factors on product Quality of Greenhouse vegetables for fresh consumption 2005; 227-234.

6. Skeketee R. Nutrition and Parasitic Diseases. *J. Nutr 2003*.; 133:1661.
7. Kang G, Matthew D, Daniel M, Mathan V. Muliyil J. Prevalence of Intestinal parasites in rural Southern India. *Trop. Med. Int. Health 1998;* 3: 70-75.
8. Center for Disease Control and Prevention. Epidemiological Information 2010; 4th Edition, Atlanta, USA.
9. Lucas S, Ajugi I, Umuh J. Helminthosis among primary school children. *Journal of Parasitology*. 2000;21: 109-116.
10. Cheesebrough H. Medical Parasitology. Medical Laboratory manual for Tropical Countries 1991; 163-411.
11. Okoronkwo M. Intestinal parasites associated with human and animal waste stabilization 1998; Ph.D Thesis, University of Jos, Nigeria.
12. Al-Shaa M, Mwafy N. The enteroparasitic Contamination of commercial vegetables in Gaza, Governorates. *J. Infect.Dev* Countries 2007; 1(1):62-66.
13. Abougrain A, Nahaisi M, Nuri, M, Mohamed S., Khaila S. Prevalence of intestinal parasites in fresh salad vegetables from wholesale and retail markets in Tripoli, Libya. *Journal homepage foodcont 2010;* 11:5.
14. Oliveira A, Germano M. Presence of intestinal parasites in vegetables sold in the metropolitan region of Sao Paulo, Brazil. *Search of Helminth.* Rev. saude publica 1992;. 26:283-289.
15. Anuar A, Ramanchandra C. Study on the prevalence of soil transmitted helminthes among lettuce leaves sold in markets in Penang, Malaysia. *Med. Journal,* Malaysia 1997; 31:262-265.
16. Porter J, Gafney C, Heymann D. Food borne outbreak of *Giardia lamblia*. *Journal of Public health 1990;* 80: 1259-1260.
17. Roberts S, John J, Gerald, D. Foundation of Parasitology 2009; 8th.ed. New York.
18. Altekruse S, Cohen M, Swerdlow D. Emerging food borne diseases. *Emerg. Infect Dis 1997;* 3:285-293.
19. Vuong A, Nguyen L, Klank D, Dalsgaard A. Faecal and protozoan parasite contamination of water spinach (Ipomoea aquatica) cultivated in urban waste water in Phnom Penh, Cambodia. *Trop. Med. Int. Health 2007;* 12: 73-81.
20. Cheesbrough M. Medical Laboratory Manual for tropical Countries, 2nd edition, University press Cambridge 2003: 200-357.
21. Neva and Brown. Basic Clinical Parasitology 5th edition Prentice-Hall International INC, USA 1983; 1-10.
22. Erwin K. Introductory mathematics statistics principles and methods: Published by John Wiley and Sons, Singapore 1970; 262-284.
23. Dauda M, Medinat M, Sabiu, T. Parasitic Contamination of Fruits and Vegetables Sold at Kaduna Metropolis, Nigeria. *Nigerian Journal of Parasitology 2011;* 32(2): 309-315.
24. Umuache N, Parasite ova and cysts on fruits sold in Calabar, Nigeria. *The journal of Parasitology* 1991;12:85-87.
25. Umoh V, Okafor C, Galadima M. Contaminated by helminthes of vegetables cultivated on land irrigated with urban waste water in Zaria and Kaduna, Nigeria. *The Nigerian Journal of Parasitology 2001;* 22(1&2): 95-104.
26. Damen J, Banwat E, Egah D, Allamana J. Parasitic Contamination of Vegetables in Jos, Nigeria. *Annal of African Medicine 2007;* 6(2): 115-118.
27. Leon W. Parasitic Contamination of Fresh Vegetables sold in Metropolian Manila, Philhipines, *South-East Journal of Tropical Medicine and Public Health 1992;* 23(1): 162-164.
28. Ohaeri C, Unogu L. Soil Transmitted Helminths of some common Vegetables in Umuahia, Abia State, Nigeria. *Nigerian Journal of Parasitology 2011;* 32(2): 305-308.
29. Stephenson LS. Impact of helminthes infection on human nutrition. Taylor and Francis, New York 1987; 252-260.
30. Shuval H, Yekutiel P, Fattai B. Epidemiological evidence for helminthes and cholera transmission by vegetables irrigated with waste water: Jerusalem, a case study. *Water science and Technology* 1984; 17: 433-442.

11/28/2014