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*Full Length Research Paper*

# Prevalence of geohelminthes on selected fruits and vegetables sold in Owerri, Imo State, Nigeria

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**Fruits and vegetables are important source needed for nutritional and medical purposes; they aid regulation of body metabolism and replenishment of needed vitamins, minerals and reduce the risk of some ailments. The consumption of contaminated fruits and vegetables may lead to parasitic infestations, infections and ailments. Attempt was made to investigate the prevalence of soil-helminthes on selected fruits (*Solanum marcrocarpon, lycopacicum esculentum, Daucus carota* and *chrysophylum albidum*) and vegetables (*Talinum trangulare, Ocimum gratissmum, Talferia occidentalis and Amaranthus viridis*) sold in selected markets in Owerri metropolis, Ihiagwa and Eziobodo all in Imo State, Nigeria. Cultivation practices by farmers and unhygienic practices associated with poor sanitation and preservation techniques by vendors and consumers was discovered to play key role in contamination of fruits and vegetables along the chain of distribution to consumption. *Talinum trangulare and lycopacicum esculentum* has the highest levels of 33% soil-helminthes contaminations respectively. The most prevalent geohelminthes in fruits and vegetables was *A. lumbricoides* and Hookworms with a percentage occurrence of 37% and 36% in fruits and 39% and 33% in vegetables. Produce from markets in Owerri metropolis and Eziobodo had the highest levels of 40% and 36% contaminations. Soil helminthes can be prevented and or destroyed in fruits and vegetables by effective human and animal waste disposal, use of well treated organic manure/waste water and effluents as fertilizers and for irrigation, thorough washing and cooking of fruits and vegetables, education of food vendors on food safety practices and application of HACCP measures.**

**Keywords**: Contamination; soil helminthes; unhygienic practices; vendors.

## INTRODUCTION

Fruits and vegetables are an important component of a healthy diet, and often contain a number of essential vitamins and minerals, carbohydrates, dietary fiber and phytochemicals that individually, or in combination demonstrate considerable antioxidant activity of important health benefit. ( Liu 2003; Syngletary et al., 2005; Percival et al, 2006; Davidson et al, 2009; Zhang et al., 2009; Oranusi and Braide, 2012b). Fruits and vegetables in the daily diet have been strongly associated with reduced risk for some forms of cancer, cardiovascular diseases (CVDs), stroke, and other chronic diseases (Liu 2003; Hung et al., 2004; Theodoratou et al., 2007; American Institute for Cancer Research, 2010). According to the WHO report 2002, low fruit and vegetable intake is estimated to cause about 31% of is chaemic heart disease and 11% of stroke worldwide. Recommendations in this direction tend to complement and reinforce other valid messages based on the long-known health benefits of consuming vegetables and fruits as dietary sources of fiber, vegetable proteins and protective micronutrients. The Joint FAO/WHO Expert Consultation on diet, nutrition and the prevention of chronic diseases, recommended the intake of a minimum of 400g of fruits and vegetables per day (excluding potatoes and other starchy tubers) for the prevention of chronic diseases such as heart disease, cancer, diabetes and obesity, as well as for the prevention and alleviation of several micronutrient deficiencies, especially in less developed countries (WHO, 2003). The recommendation thus adds to the already strong case for the health benefits to be gained from the consumption of fruits and vegetables and paves

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the way for concrete action advocating increased consumption of these commodities. Although each fruit and vegetable is unique in its composition, no one fruit or vegetable is known to contain all that is desired from its consumption, however, combinations of them in a meal or from different meals will suffice.

*Talinum trangulare* commonly called water-leave contain Omega -3- fatty acid and high levels of nutritionally important vitamins such as Vitamin C, E, and beta-carotene. Minerals such as calcium, magnesium and potassium and soluble fibers (pectin) contribute to the highly elevated antioxidant values of the vegetable. (Ezekwe et al., 2004). Other phytochemicals and bioactive compounds present in the plant are saponins, phytic acid, tannic acid and oxalate, flavonoids and alkaloids, (Akindahunsi and Salawu, 2005).

*Ocimum gratissimum* known as scent leaf, contain carbohydrates and phytochemicals like alkaloids, tannins, flavoniods and trepenoids (Gupta et al., 2011). It contains high water and dietary fiber, minerals like phosphorus, selenium, iron and zinc (Oboh et al., 2009). It is low in protein content which is commonly present in form of enzymes. The antimicrobial activity of *Ocimum gratissimum* recorded a positive result with *S. aureus* and *E. coil* (Oboh et al., 2009). The stem of the plant has ability to induce abortion (Angana, 2012).

*Telfairia occidentalis* (Pumpkin leaves) is rich in minerals such as iron, potassium, sodium, phosphorus, calcium and magnesium, antioxidants, vitamins such as thiamine, riboflavin, nicotinamide and ascorbic acid, phytochemicals such as phenols (Longe et al., 1983; Ladeji et al., 1995; Oboh, 2005; Fasuyi, 2006; Oboh et al., 2006; Kayode et al., 2009; Williams et al. 2009). The essential amino acids contents compared favorably with those of important legumes and includes alanine, aspartate, glycine, glutamine, histidine, lysine, methionine, tryptophan, cystine, leucine, arginine, serine, threonine, phenylalanine, valine, tyrosine and isoleucine ( Fasuyi, 2006., Emeka and Obidoa,2009., Kayode et al., 2010).

*Daucus carota* (carrot) contain β-carotene, which is metabolized into vitamin A in humans when bile salts are present in the intestines, this vitamin A improve vision (Mikkelson, 2012). Carrots are also rich in dietary fiber, antioxidants, and minerals. Ethno medically, the roots are used to treat digestive problems, intestinal parasites, and tonsillitis or constipation. (Oranusi and Braide, 2012b; Wikipedia, 2012)

*Lycopacicum esculentum* (Tomato) While it is botanically a fruit, it is considered a vegetable for culinary purposes, they contain the carotene lycopene, one of the most powerful natural antioxidants, their consumption is believed to benefit the heart, among other organs. Tomatoes and tomato sauces and puree are said to help lower urinary tract symptoms (Benign Prostatic Hyperplasia) and may have anticancer properties (Giovannucci et al., 2002; Shidfer et al, 2011). Lycopene, has been found to help prevent prostate cancer, (Giovannucci et al, 2002), improve the skin's ability to protect against harmful UV rays. (Mourvaki et al., 2005), decreased risk of breast cancer (Freedman et al, 2008), head and neck cancers (Rao and Balachandran, 2002), and might be strongly protective against neurodegenerative diseases (Suganuma et al., 2002; Polivkova et al., 2011).

Despite the health benefits, fruits and vegetables have been known to serve as vehicle to human disease causing agents (FAO 2010; WHO, 2012). The channels through which fruits and vegetables get to the final consumer are possible routes of contamination, and any unhygienic practices in their preparations could lead to incidence of human illness or infection resulting from the consumption of contaminated products.

Fresh fruits and vegetables can be agents of transmission of protozoa cysts and helminthes eggs and larvae. (Coelho et al, 2001; Erdogrul and Sener, 2005; Daryani et al., 2008). Vegetables can become contaminated with parasitic pathogens throughout the process of planting to consumption. The extent of contamination depends on so many factors which may includes; application of night soil, animal manure and the use of untreated wastewater and water supplies contaminated with sewage as an organic or agricultural fertilizer and for irrigation, coupled with the unhygienic practice of the farmers during harvest, post-harvest handling by vendors, poverty and hygienic conditions of preparation in food service or home settings (Amoah et al., 2007; Obgolu et al., 2009).

This work investigates the prevalence of soil helminthes on some selected fruits and vegetables commonly consumed in Owerri, determine the markets (sales outlets) with the highest levels of contaminated produce and the possible responsible factors with a view to proffering measures to curb or reduce contaminations and its attendant health implications.

## MATERIALS AND METHODS

### Sampling

Two methods were adopted for the collection of data for this research. First was the questionnaire interview for the farmers, vendors and consumers of fruits and vegetable produce, to ascertain the possible sources and causes of contamination via these subjects. The opinion of one hundred and twenty seven (127) respondents comprising of 22 farmers, 43 consumers and 62 vendors was documented. All the subjects' level of education was ascertained. The farmers were interviewed for farming practices that could lead to contamination of produce such as fertilizer application (untreated organic/treated organic/ inorganic), source of water for irrigation and means of transportation of produce from the farm to the

**Table 1.** Farmers (n= 22) relationship with farm produce

| **Characteristics of farmers that could lead to contamination of produce n (%)** | | | | | |
|---|---|---|---|---|---|
| 1. Highest level of education attained | | | | | |
| (a) Primary | (b) Secondary | (c) Diploma | (d) B.Sc/BA | (e) M.Sc/Ph.D | (f) No education |
| 2(9.09) | 1(4.55) | - | - | - | 19(86.36) |
| 2. Type of fertilizer used in growing fruits/vegetables | | | | | |
| (a) Inorganic | (b) treated organic | (c) untreated organic | | | |
| 10(45.45) | - | 12(54.55) | | | |
| 3. What is/ are the reason(s) for choice of fertilizer | | | | | |
| (a) Cost | (b) availability | (c) sanitary/safety considerations | | (d) better crop yield | |
| 15(68.18) | 7(31.82) | - | | - | |
| 4. Source of water for irrigation | | | | | |
| (a) River | (b) pond | (c) well | (d) borehole | (d) run-off wastes from households | |
| 7(31.82) | 4(18.18) | 3(13.64) | - | 8(36.36) | |
| 5. Means of transporting produce to the market/point of sale (*dedicated/not dedicated) | | | | | |
| (a) Motor vehicle | (b) tricycle/motorcycle/bicycle | | (c) wheel barrow | (d) basket/head | |
| 5(22.73) | 7(31.82) | | 5(22.73) | 5(22.73) | |

market. Vendors quizzed for source(s) of goods (direct from the farmers/middle men/home garden), mode of treatment before display for sales (washed/unwashed), means of vending(displayed on bare floor by road side/hawked in wheel barrow/basins/baskets), means of transportation of produce to the market, means of preservation of left over. Consumers were interviewed on how regular they consume fruits and vegetables, the purpose for consuming vegetables and fruits, sanitary condition in terms of washing before consumption, cooking/processing practices, preservation after purchase and processing(refrigeration or otherwise).

Second method was the laboratory investigation of the selected fruits and vegetables to ascertain the kind of microorganism prevalent in the fruits and vegetables and in produce from different markets.

A total of 72 samples of fruits and vegetables were collected randomly from the three selected markets in Owerri, Ihiagwa and Eziobodo. Parasitological investigation was carried out on each of the selected fruits *Solanum marcrocarpon* (Garden egg), *Lecopacicon* esculentum (Tomato), *Daucus* carota (Carrot), *Chrysophyllum albidun*: (white star apple or Cherry) and Vegetables *Talinum trangulare* (water leaf), *Amaranthus viridis* (green leaf), *Telferiria occidentalis* (Pumpkin), *Ocimum gratissimum* (Scent leaf) respectively. The samples were obtained over a period of 3 weeks to allow for different batches/stock of produce in the markets.

### Sample analysis

The method Wafa (2010) was adopted, 250 grams of each sample was weighed and sliced into bits, and was placed in a conical flasks of 250ml with 0.95% physiological saline to wash out colonizing parasites/parasite stages from surfaces of the samples. The wash water was left overnight and sieved to remove debris after which it was dispensed into centrifuge tubes and centrifuged at 2000rpm for 20min. Following centrifugation the supernatant was discarded and the residue was carefully mixed, a drop was placed on a grease free slide with the addition of tincture of iodine and was examined for parasites stages under the microscope using the ×10 and × 40 objective lenses. Parasites were identified following the descriptions of Cheesbrough 2004

## RESULTS

The practices of the farmers that could lead to contamination of produce are as shown in table 1. Approximately 19(86.36%) of the farmers had no formal education, 12(54.55%) use untreated organic fertilizer (organic manure) while 8(36.36%) use run off waste water for irrigation. Fourteen (63.64%) use untreated water from rivers, ponds and wells for irrigation. All (100%) of the farmers use non-dedicated means of transportation to convey produce to point of sale i.e transport means used for other purposes other than transport of farm produce. Table 2 shows that 55(88.71%) of the vendors had no formal education, 54.84% obtain their goods from middle men, 74.19% do not wash produce before sales. About 80.65% of the vendors display produce on the ground by the road sides in the market for sales, 2(3.22%) hawk their goods in wheel barrow. All (100%) the vendors use non-dedicated means of transportation to convey goods to the market for sales and none of the vendors preserved left over

**Table 2**. Vendors (n= 62) relationship with farm produce

| **Characteristics of vendors that could lead to contamination of produce n (%)** | | | | | |
|---|---|---|---|---|---|
| 1. Highest level of education attained | | | | | |
| (a) Primary | (b) Secondary | (c) Diploma | (d) B.Sc/BA | (e) M.Sc/Ph.D | (f) No education |
| 5(8.06) | 2(3.22) | - | - | - | 55(88.71) |
| 2. Sources of fruits/vegetables for vending | | | | | |
| (a) Direct from farmers | (b) from middle men | (c) from private garden | | | |
| 16(25.81) | 34(54.84) | 12(19.35) | | | |
| 3. Produce washed before display for sales | | | | | |
| (a) Yes | (b) No | | | | |
| 16(25.81) | 46(74.19) | | | | |
| 4. Means of display of goods for sales | | | | | |
| (a) Hawk in wheel barrow/baskets | (b) spread on the floor by the road sides | (c) on shelves in shops | (d) on tables by the road sides | . | |
| 2(3.22) | 50(80.65) | - | 10(16.13) | | |
| 5. Means of transporting produce to the market/point of sale (*dedicated/not dedicated) | | | | | |
| (a) Motor vehicle | (b) tricycle/motorcycle/bicycle | (c) wheel barrow | (d) basket/head | | |
| 29(46.77) | 15(24.19) | 11(17.74) | 7(11.29) | | |
| 6. Means of preservation of left over produce | | | | | |
| (a) Fridge | (b) wrapped in sacks/leaves | (c) left in evening/night dew | (d) any other | | |
| - | 29(46.77) | 33(53.23) | - | | |

**Table 3.** Consumers (n= 43) relationship with farm produce

| **Characteristics of consumers that could lead to contamination of produce n (%)** | | | | | |
|---|---|---|---|---|---|
| 1. Highest level of education attained | | | | | |
| (a) Primary | (b) Secondary | (c) Diploma | (d) B.Sc/BA | (e) M.Sc/Ph.D | (f) No education |
| 6(13.95) | 9(20.93) | 4(9.30) | 7(16.28) | 13(30.23) | 4(9.30) |
| 2. Monthly income level (in thousand Naira) | | | | | |
| (a) 10-20 | (b) 21-50 | (c) 51-100 | (d) 150-250 | (e) above 250 | |
| 14(32.56) | 14(32.56) | 8(18.60) | 4(9.30) | 3(6.98) | |
| 3. Produce washed before consumption | | | | | |
| (a) Yes always | yes sometimes | (c) No | | | |
| 25(58.14) | 13(30.23) | 5(11.63) | | | |
| 4. Preferred treatment/processing before consumption | | | | | |
| (a) Fully cooked | (b) moderately cooked | (c) under cooked | (d) raw if it can be eaten raw | | |
| 10(23.26) | 18(41.86) | 15(34.83) | 39(90.70) | | |
| 5. How often are fruits/ vegetables consumed as part of your meal? | | | | | |
| (a) Regularly (at least 4-7 times weekly) | (b) not regularly (at least once monthly) | (c) once in a while (at least once in 2 months) | | | |
| 15(34.83) | 25(58.14) | 3(6.98) | | | |
| 6. Reason(s) for eating fruits/vegetables | | | | | |
| (a) Nutritional need | (b) medicinal | (c) luxury | | | |
| 26(60.46) | 10(23.26) | 7(16.28) | | | |
| 7. Means of preservation of produce if not cooked/processed same day | | | | | |
| (a) Fridge | (b) wrapped in sacks/leaves | (c) left in evening/night dew | (d) any other | | |
| 16(37.20) | 9(20.94) | 18(41.86) | - | | |

produce in the refrigerator for next day sales. Table 3 reveals that only 9.30% of the consumers had no formal education, 58.14% of the consumers wash fruits and vegetables regularly before consumption, 34.83% and 41.86% preferred undercooked/moderately cooked vegetables while 37.20% store produce in the fridge if not cooked/processed same day. Figures 1a and 1b show the levels of contaminations of the vegetables and fruits, *T. trangulare* and L*. esculentum* had the highest levels of 33% helminthes contaminations respectively. Figures 2a

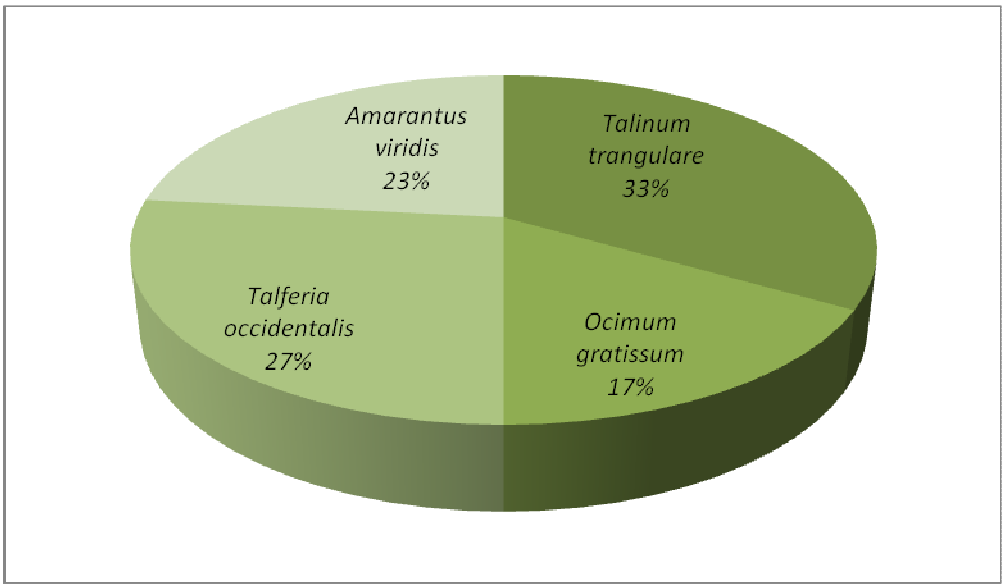


**Figure1a.** Percentage levels of contamination of vegetables with different Soil-helminthes

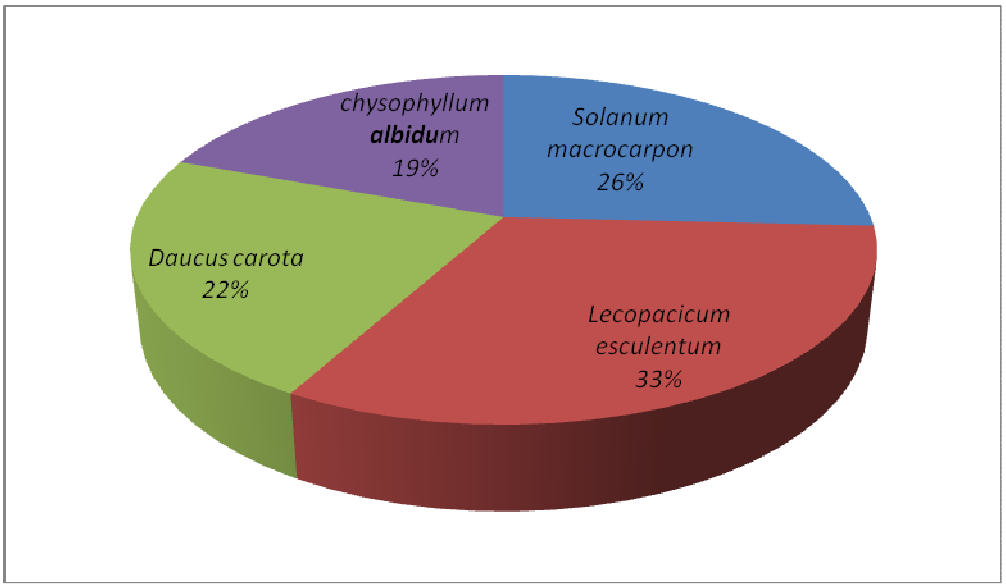


**Figure1b.** Percentage levels of contamination of fruits with different Soil-helminthes

and 2b reveal that *A. lumbricoides* and Hookworms are the most prevalent geohelminthes in the fruits and vegetables with 33% to 39% contamination rates. Produce from markets in Owerri metropolis and Eziobodo had the highest levels of contamination Figures 3a and 3b.

## DISCUSSION

The important nature of fruits and vegetable to man especially as regards nutrition, curative medicine as well as its economic importance cannot be over emphasized. The use of the questionnaire interview gave clue on some of the basic means by which fruits and vegetables are contaminated from the Farmers, Vendors and Consumers.

Approximately 54.55% of farmers investigated apply untreated organic manure while 45.45% use inorganic fertilizer for the cultivation of the fruits and vegetables, choice of fertilizer was dependent mainly on cost and availability. The expensive cost of the inorganic fertilizers makes farmer opt for the untreated organic fertilizer

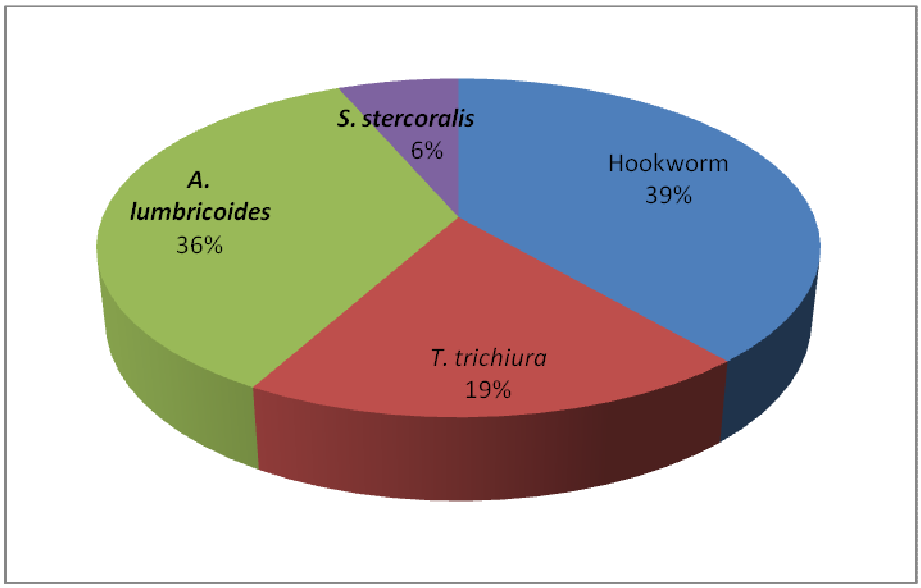


**Figure 2a.** Prevalence of soil-helminthes from fruits in the investigated markets

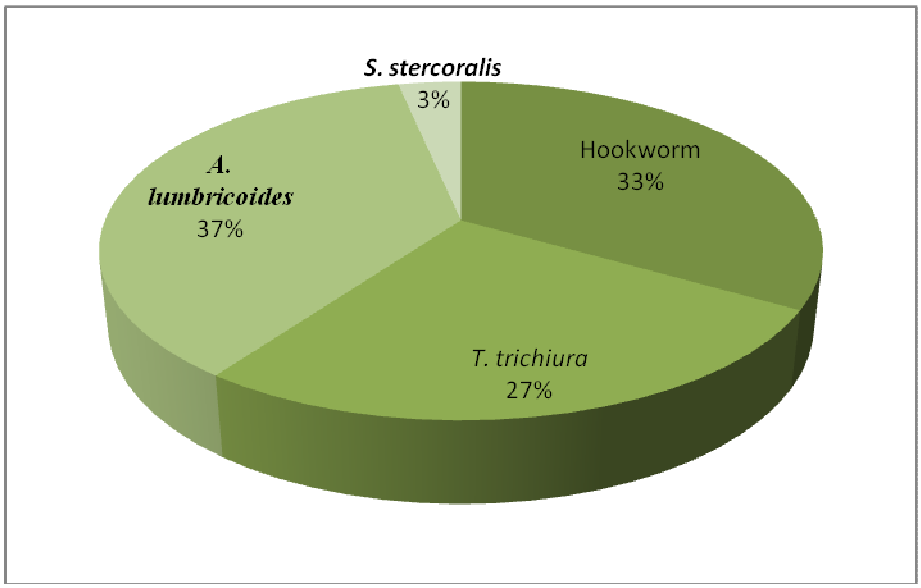


**Figure 2b.** Prevalence of soil-helminthes from Vegetables in the investigated markets.

consequences inherent in the use of untreated organic fertilizer is that, there is the possibility of fruits and vegetables being contaminated by feacal helminthes eggs or larvae (Umoh et al., 2001; Beuchat, 2002; Erdogrul and Sener, 2005; Daryani at al., 2008; Wafa, 2010; ). That yield and sanitary considerations was not a factor in determining choice of fertilizer could be seen from the farmers' levels of education, only 3(13.64%) had primary and secondary education. The vessels for conveying produce constitute another hazard in the contamination of fruits and vegetables. All the farmers us transport means not strictly dedicated to conveying farm produce, cross contamination from other activities to which these transport means had been used could contribute immensely to produce contamination.

Vendors' serves as intermediary between the producer farmers and the final consumers, they play an important role in the chain of distribution of fruits and

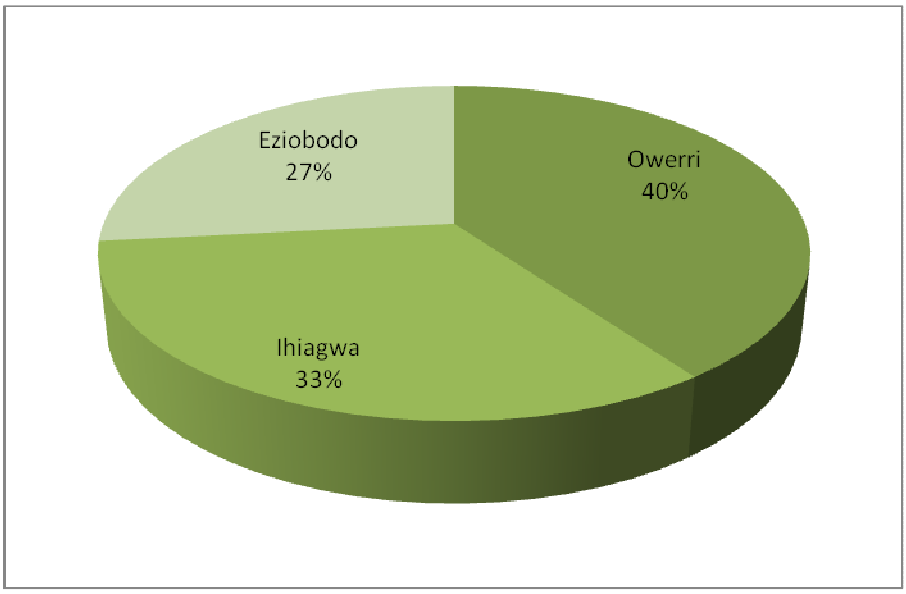


**Figure 3a.** Soil-helminthes contamination levels of vegetables in each market

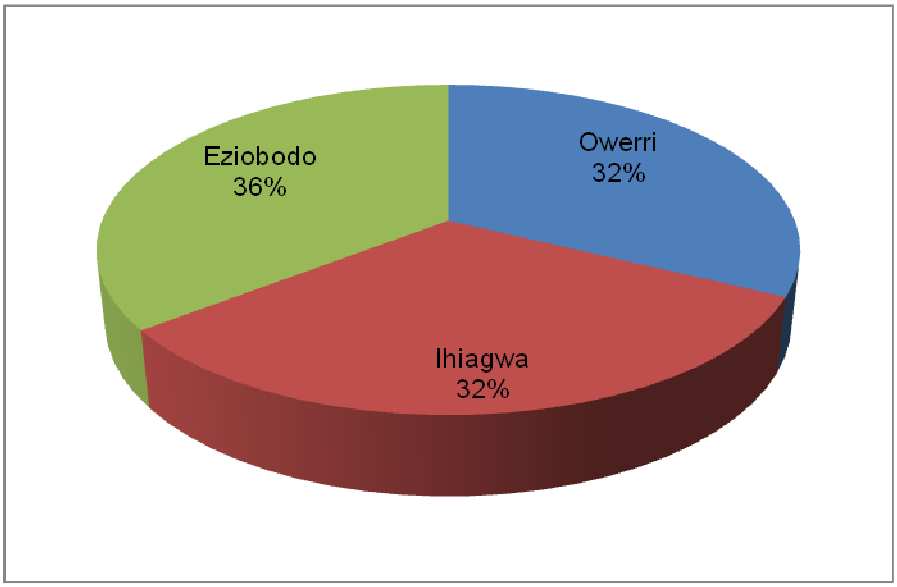


**Figure 3b.** Soil-helminthes contamination levels of fruits in each market

vegetables produce and also in the contamination and distribution of contaminants (Erdogrul and Sener, 2005; Oranusi and Braide, 2012a, b). An average of 54.84% of vendors buys their produce from middle men and 25.81% got directly from farmers. Middle men have been reported as major contributors to food contamination because their major target is profit maximization, thus cheapest means of transportation of produce, sharp practices and utter disregard to sanitary quality of produces is a hall mark. This report showed that an average of 74.19% of vendors do not wash their produce before display for sale, 80.65% displayed their goods on road side exposed to dust, flies and other insects, these practices coupled with handling of produce by different customers during bargains/business transactions could contribute to contamination of produce (Wafa, 2010; Oranusi and Braide, 2012a, b). The preservation methods adopted by vendors could also be a contributor to the contamination/proliferation of contaminants in the fruits and vegetables. About 53.23% preserve their left over in

humid atmosphere, while 46.77% preserve by wrapping with fresh leaves. Humid environment could encourage the preservation /proliferation of geohelminthes and the use of fresh leaves of unknown sanitary condition could well increase the parasitic load of the produce (WHO, 1998; Beuchat, 2002). Only 7(11.29%) of the vendors had primary and secondary education, this implies that food safety norms are not known by most of the vendors (Oranusi et al, 2012a,b).

The interest of the consumers was of utmost importance, this is because they are at the risk bearing end as the end user of these agricultural products. In consuming fruits and vegetables, the cleanliness of the produce had to be considered before consumption, from results obtained it showed that while 25(58.14%) of consumers wash their produce regularly before consumption, 18(41.86%) may wash or do not wash vegetables/fruits before consumption, this could be a reflection of the number of consumers without education or low level of education 44.19%. Fruits and vegetables are veritable source of microbial pathogens and helminthes (Erdogrul and Sener, 2005; Wafa, 2010; Eni et al, 2010, WHO, 2012). Although undercooked and moderately cooked food has potential of retaining more nutrients, the ability to retain more pathogens is equally of concern. In this study, only 10(23.26%) desired fully cooked/processed vegetables and fruits, this indicate a high possibility of pathogen transmission to consumers if and when adequate washing is lacking. It was observed that about 34.83% of consumers feed on fruits and vegetables almost on daily basis, while 65.12% do not. This implies that a good percentage of the populations (34.83%) are prone to geohelminthes infection through vegetable and fruits consumption. Soil-helminths are known to be the causes of morbidities, nutritional deficiencies, maternal motality, impaired physical developments and learning abilities in pre-school and school children and socioeconomic deprivations in populations living in the tropics of Asia, the sub-Saharan Africa and where poor hygiene conditions provide an optimal environment for their development and transmission. (De silva et al., 2003 and Ekpo et al., 2007).

That 65.12% of the consumer population do not take vegetable and fruit regularly or at all, prove that the health benefits of these produce is not available to many. This also corroborates the fact that 16.28% of the population takes fruits/vegetable as luxury while 23.26% took it as medicine. Preservation is another area that either encourages the growth of soil-helminthes in contamination or retards the growth of inherent soil-helminthes. An average of 37.20% preserve by refrigerating, 41.86% by dew and 20.94% preserves with fresh leaves. Though this methods are efficient, but there is the possibility of recontamination and proliferation of existing contaminate, depending on the kind of fruits and vegetable products, the use of fresh leaves which may have been contaminated with soil helminthes may add to the existing ones on the fruits and vegetables, thus increasing the parasitic load on the product, more so, the temperature and condition at which the product is preserved may also encourage the proliferation of inherent soil helminthes. Preserving under humid condition could encourage proliferation/hatching of soil helminthes eggs or larvae.

Prevention of contamination remains the most efficient ways to ensure food safety and prevention of helminthiasis, effort should be made to protect food from primary source of contamination. Proper treatment of wastewater, sludge, sewage, animal manure and other material that comes in contact with cultivating soil, reduce the parasitic load of the cultivating soil and reduce the need for the use of artificial methods of sanitizing these fruits and vegetables. Adequate washing of vegetables and fruits with portable water before processing is emphasized. Enlightenment campaign, good sanitary condition, environmental friendly policies by government, sanitation laws, programmes like the Hazard analysis and critical control points (HACCP) and Good agricultural practice (GAP) is necessary to reduce the morbidity associated with these infection.

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