Parasitological Assessment of Green Leafy Vegetables Sold at Masaka and Karu Markets in Nasarawa State of Nigeria

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Abstract	Original Research Article

This research studied the Parasitological Assessment of Green leafy vegetables sold at Masaka market Karu. The vegetables were purchased from masaka market three times a week and washed for two minutes in 250ml of normal saline and spun in a centrifuge at 3000rpm for 5 minutes, smears made on glass slides were prepared from the deposits post centrifugation, sample slides was stained with lugol's iodine and viewed in x10 and x40 objectives. Five parasites including *Hookworm, Taenia spp, Ascaris lumbricoides, Entameoba histolytica* and *Trichuris trichura. Hookworm* had the highest frequency and *Ascaris lumbricoides* with the lowest. A total of 10 types of vegetables were, these were, Fluted pumpkin leaf, lettuce, spinach, scent leaf, false cubeb leaf, sorrel leaf, cabbage, curry leaf, Waterleaf and Garden egg leaf. False cubeb leaf had the highest contamination while scent leaf had the lowest. A total of 200 vegetables washed were used, 129 were contaminated while 71 were not. Total prevalence of parasites present in this study was gotten to be was 64.5% with hookworm as the highest (34.5%). Data analysis was carried out by Chi square test the value was gotten to be 50.000 with df of 25. The P value was gotten to be 0.02 which is less than 0.05 which proves the alternate hypothesis to be accepted and alternate to be accepted. This shows that there was parasitic contamination present in these vegetables sold at Masaka market, Karu.
Keywords: Green leafy vegetables, masaka market, *Ascaris lumbricoides,* hypothesis, Parasitological Assessment.

LITERATURE REVIEW

Parasites

Parasites are organisms which have adapted themselves in or on another organism which is called a host, and lives at the expenses of the tissue and fluid of the host deriving their nutrient and protection from the host, thereby harming or being of no advantage to the host [1]. They increase their fitness by exploiting host for food, habitat and dispersal. Parasites may be transmitted from animals to humans, from humans to humans, or from humans to animals. Several parasites have emerged as significant cause of food borne and water borne disease in the whole world. This can be achieved through consumption of contaminated food and water or by eating any raw vegetables that has been contaminated with parasites. This work is to access various parasites associated with green leafy vegetables such as Fluted pumpkin leaf (*Telfairia occidentallis*), Water leaf (*Hydrophyllum triangulare*), Lettuce(*Lactuca sativa*), Spinach (*Amaranthus hybridus*), Garden egg leaf (*Solanum aethiopicum*), False cubeb leaf(*Piper guineense*), Curry leaf (Murraya koenigii), Sorrel leaf (Rumex acetosa), Cabbage (*Brassica oleracea var. capitata*) and Scent leaf (Ocimun gratissimum) Parasites are of different types and ranges in size from tiny-single-celled, microscopic organisms (protozoa) to large multi-cellular worms, (helminthes) that may be seen with a microscope [2]. Some of the parasites are: *Giardia lamblia (intestinalis)*, *Hookworm Ascaris lumbricoides*, *Trichuris trichura, Schistosoma spp*

Giardia lamblia it *causes* Giardiasis, It is one celled microscopic parasites that can live in the intestine of animals and humans. It is found in every region throughout the world and may cause chronic diarrhea, malabsorptoin, weight loss with symptoms for several months [3]. Giardiasis is mainly acquired by transmission of cysts of *Giardia lamblia* and soiled hands, contaminated with faeces [4]. *Lamblia* cyst have

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been detected in flies that may serve as a vector for contamination of foods [5]. Consumers get this disease by consuming vegetables contaminated with *G. duodenalis* cysts (infective stage of the organism) and by putting anything into the mouth that has touched the stool of a person or animal with giardiasis. The illness usually goes away without medical intervention in three to four days. But in some outbreaks in day care centers diarrhea has lasted one to four weeks. In people with weakened immune system, cryptosporidiosis can be serious, long lasting and sometimes fatal. However, there is no known effective drug or medication whatsoever for the treatment of cryptosporidiosis [4].

Hookworm is a nematode parasite that lives in the small intestine of its host, which may be a mammal such as a dog, cat, or human. Two species of hookworms commonly infect humans *Ancylostoma duodenale* and *Necator americanus*. The geographical distribution of these two species significantly overlaps. *Necator americanus* predominates in the Americas,

Sub-Saharan Africa, Southeast Asia, China and Indonesia, while *A. duodenale* predominates in the Middle East, North Africa, India and (formerly) in southern Europe. Hookworms are thought to infect 800 million people worldwide. Hookworms are much smaller than the large roundworm, *Ascaris lumbricoides*. The most significant risk of hookworm infection is anemia, secondary to loss of iron (and protein) in the gut. The worms suck blood and damage the mucosa. However, the blood loss in the stools is occult blood loss (not visibly apparent). They are the leading cause of maternal and child morbidity in the developing countries of the tropics and subtropics. In susceptible children hookworms cause intellectual, cognitive and growth retardation, intrauterine growth retardation, prematurity and low birth weight among newborns born to infected mothers. Hookworm infection is rarely fatal, but anemia can be significant in the heavily infected individual. Hookworm infection of human beings occurs through the penetration of the filariform larvae through the feet.
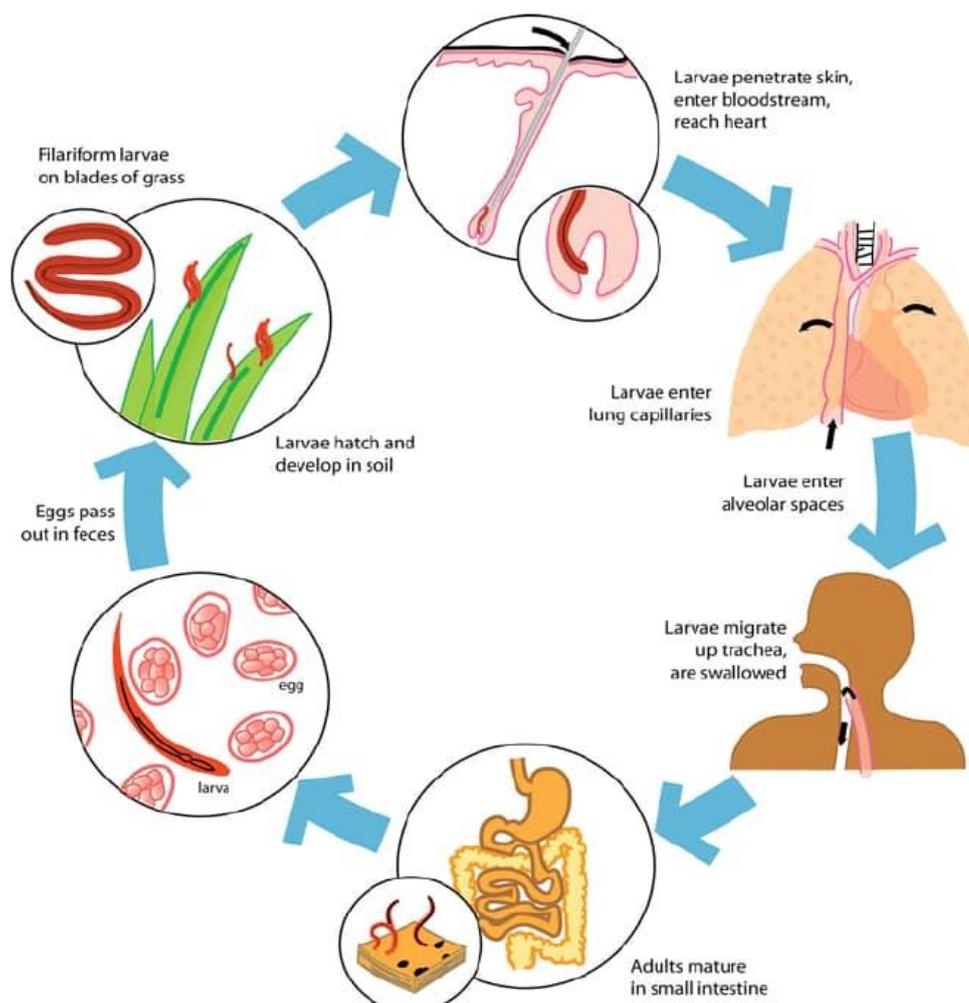

Fig 1: Lifecycle of a hookworm source:http://www.dpd.cdc.gov/dpdx [6]

Ascaris lumbricoides is a parasitic round worm causes Ascariasis a debilitating human disease. Perhaps as many as one quarter of the world's people is infected, and ascariasis is particularly prevalent in tropical

regions and in areas of poor hygiene. Other species of the genus *Ascaris* are parasitic and can cause disease in domestic animals. Infection occurs through ingestion of food contaminated with fecal matter containing *Ascaris*

eggs. The larvae hatch, burrow through the intestine, reach the lungs, and finally migrate up the respiratory tract. From there they are then swallowed and mature in the intestine, growing up to 30 cm (12 in.) in length and anchoring themselves to the intestinal wall. Infections are usually accompanied by inflammation, fever, and diarrhea, and serious problems may develop if the worms migrate to other parts of the body. About 1.5 billion individuals are infected with this worm. Ascariasis is endemic in the United States, China, Ozark Mountains; Southeast Asia, central Africa and the coastal regions of the West Africa. Ascariasis sources can often be measured by examining food for ova. In one field study in Marrakech, Morocco, where raw sewage was used to fertilize crop fields, 73% of children working on these farms were infected with helminthes, particularly *Ascaris,* probably as a result of exposure to the raw sewage. Roundworm infections can retard growth. They decrease the absorption of nutrients that the body needs to grow. They cause structural problems in the small intestine in children and are thought to be a cause of frequent or serious pulmonary disease among children. Intestinal obstructions frequently result in the hospitalization of children.

Death is common in children when worms move to organs outside of the intestines such as the trachea, liver, and heart, or when complications occur. Adult worms (Fig 2) live in the lumen of the small intestine. A female may produce approximately 200,000 eggs per day, which are passed with the feces (Fig 2). Unfertilized eggs may be ingested but are not infective. Fertile eggs embryonated and become infective after 18 days to several weeks (Fig 2), depending on the environmental conditions (optimum: moist, warm, shaded soil). After infective eggs are swallowed, the larvae hatch, invade the intestinal mucosa, and are carried via the portal, then systemic circulation to the lungs. The larvae mature further in the lungs (10 to 14 days), penetrate the alveolar walls, ascend the bronchial tree to the throat, and are swallowed.

Upon reaching the small intestine, they develop into adult worms (Fig 2). Between 2 and 3 months are required from ingestion of the infective eggs to oviposition by the adult female. Adult worms can live 1 to 2 years. Source: http://www.dpd.cdc.gov/dpdx [6]
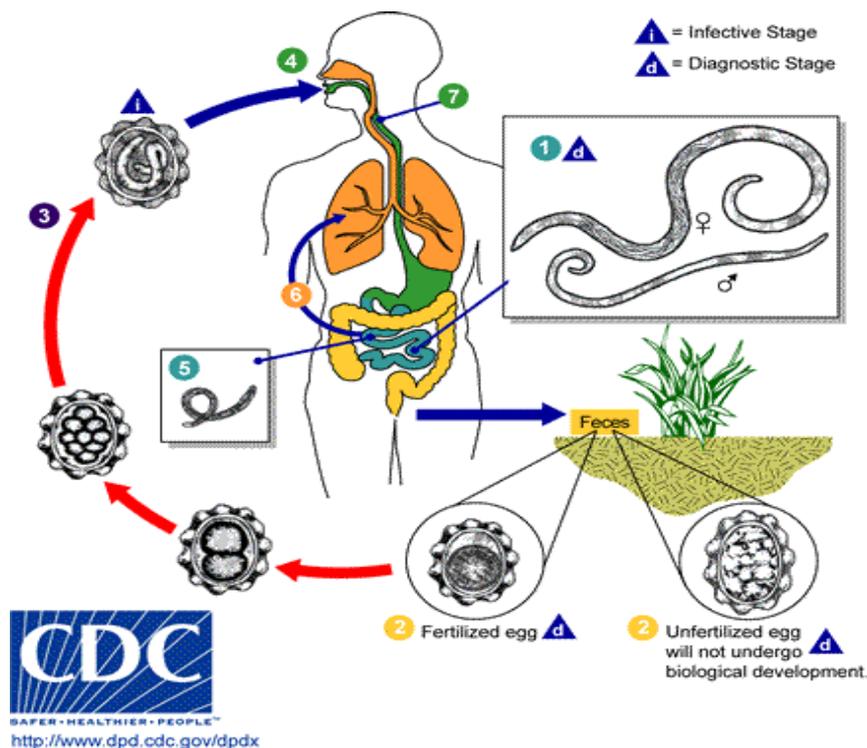

Fig 2: Life cycle of *Ascaris lumbricoides* source: *http://www.dpd.cdc.gov/dpdx* [6]

Trichuris trichura is the third most common round worm of humans, with infections more frequent in areas with tropical weather and poor sanitation practices, especially in Asia and, to a lesser degree, in Africa and South America., and among children. It is estimated that 800 million people are infected worldwide. There is a worldwide distribution of *Trichuris trichura*, with an estimated 1 billion human infections. Poor hygiene is associated with trichuriasis

as well as the consumption of shaded moist soil, or food that may have been fecally contaminated. Children are especially vulnerable to infection due to their high exposure risk. Eggs are infective about 2–3 weeks after they are deposited in the soil under proper conditions of warmth and moisture, hence its tropical distribution. The eggs hatch in the small intestine and then move into the wall of the small intestine and develop. On reaching adulthood, the thinner end (the front of the worm)

burrows into the large intestine and the thicker end hangs into the lumen and mates with nearby worms. The females can grow up to 50 mm (2 inches) long. Neither the male nor the female has much of a visible tail past the anus. Whipworm commonly infects patients also infected with *Giardia*, *Endameba histolytica*,

Ascaris lumbricoides, and hookworms. Infection with this parasite is through the ingestion of the embryonated eggs which then hatch into larvae in the small intestine, mature into adults in the cecum. The adult worms then lay eggs that are passed out in feaces. source: http://www.dpd.cdc.gov/dpdx [6]
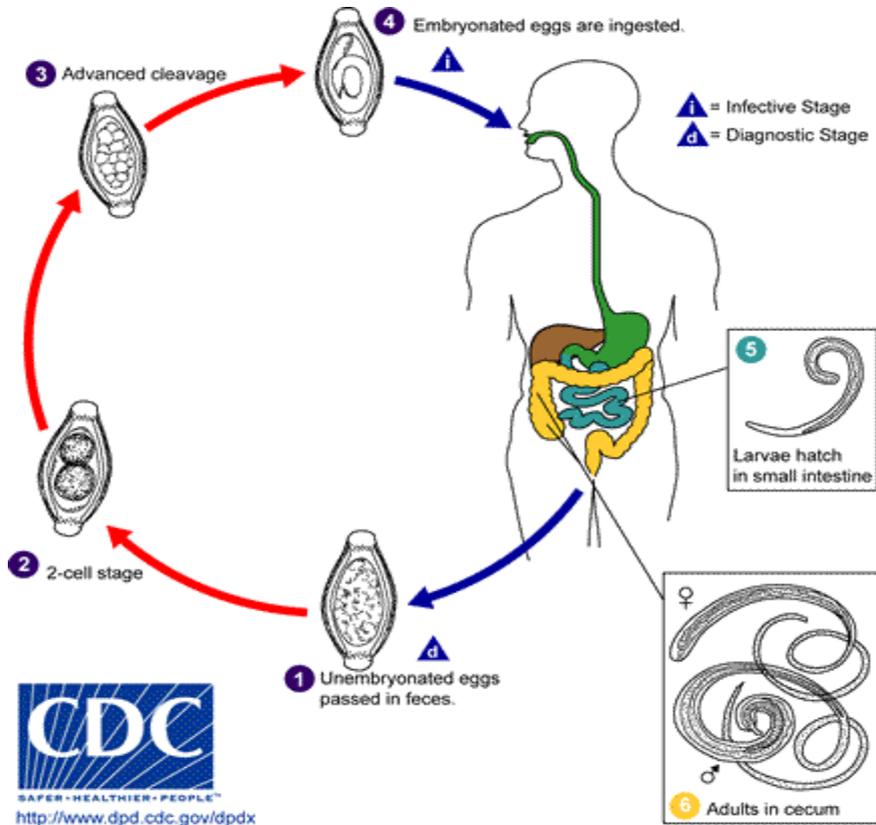

Fig 3: Life cycle of *Trichuris trichura*

Schistosoma spp have a typical trematode vertebrate-invertebrate lifecycle, with humans being the definitive host. The life cycles of all five human Schistosoma are broadly similar: parasite eggs are released into the environment from infected individuals, hatching on contact with fresh water to release the free-swimming miracidium. Miracidia infect freshwater snails by penetrating the foot. After infection, close to the site of penetration, the miracidium transforms into a primary (mother) sporocyst. Germ cells within the primary sporocyst will then begin dividing to produce secondary (daughter) sporocysts, which migrate to the snail's hepatopancreas. Once at the hepatopancreas, germ cells within the secondary sporocyst begin to divide again, this time producing thousands of new parasites, known as cercariae, which are the larvae capable of infecting mammals. Cercariae emerge daily from the snail host in a circadian rhythm, dependent on ambient temperature and light. Young cercariae are highly mobile, alternating between vigorous upward movements and sinking to maintain their position in the water. Cercarial activity is particularly stimulated by water turbulence, by shadows and by chemicals found on human skin. Penetration of the human skin occurs

after the cercaria has attached itself to the skin. The parasite secretes enzymes that break down the skin's protein to enable penetration of the cercarial head through the skin. As the cercaria penetrates the skin it develops into a migrating schistosomulum stage. The newly transformed schistosomulum may remain in the skin for two days before locating a post-capillary venule; from here the schistosomulum travels to the lungs where it undergoes further developmental changes necessary for subsequent migration to the liver. Eight to ten days after penetration of the skin, the parasite migrates to the liver sinusoids. *S. japonicum* migrates more quickly than *S. mansoni*, and usually reaches the liver within eight days of penetration. Juvenile *S. mansoni* and *S. japonicum* worms develop an oral sucker after arriving at the liver, and it is during this period that the parasite begins to feed on red blood cells (Fig. 4). The nearly-mature worms pair, with the longer female worm residing in the gynaecophoric channel of the shorter male. Adult worms are about 10 mm long. Worm pairs of *S. mansoni* and *S. japonicum* relocate to the mesenteric or rectal veins. Parasites reach maturity in six to eight weeks, at which time they begin to produce eggs. Adult *S. mansoni* pairs residing

in the mesenteric vessels may produce up to 300 eggs per day during their reproductive lives. *S. japonicum* may produce up to 3,000 eggs per day. Many of the eggs pass through the walls of the blood vessels, and through the intestinal wall, to be passed out of the body in feces. *S. haematobium* eggs pass through the ureteral or bladder wall and into the urine. Only mature eggs are capable of crossing into the digestive tract, possibly through the release of proteolytic enzymes, but also as a function of host immune response, which fosters local tissue ulceration. Up to half the eggs released by the

worm pairs become trapped in the mesenteric veins, or will be washed back into the liver, where they will become lodged. Worm pairs can live in the body for an average of four and a half years, but may persist up to twenty years. Trapped eggs mature normally, secreting antigens that elicit a vigorous immune response. The eggs themselves do not damage the body. Rather it is the cellular infiltration resultant from the immune response that causes the pathology classically associated with schistosomiasis. Source: http://www.dpd.cdc.gov/dpdx [6].
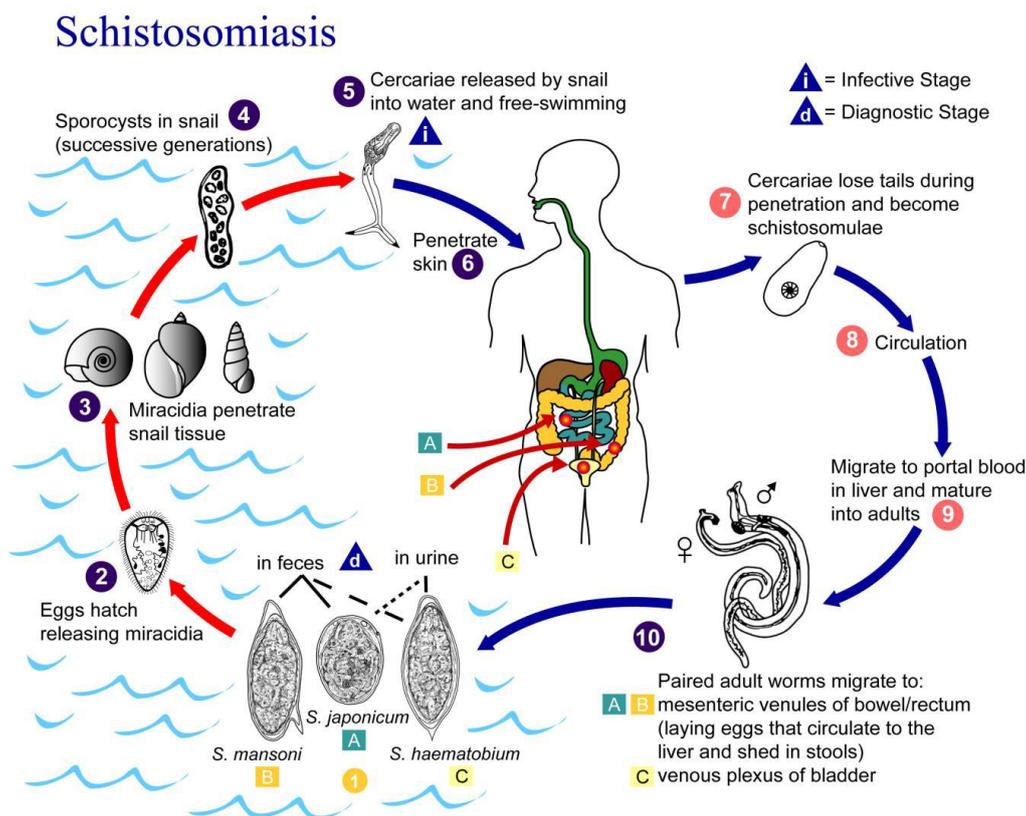

Fig 4: Life cycle of *Schistosoma spp* source:http://www.dpd.cdc.gov/dpdx

Persons of all ages are at risk for infection. Untreated manure should not be used to fertilize vegetables. Vegetables normally carry a non-pathogenic epiphytic micro-flora. Hence, there are certain factors which contribute the microbiological contamination of these products with pathogens. Consequences of treating soil with organic fertilizers such as manure, and savage sludge from irrigation water harvesting, cutting, slicing, etc result in the parasitic contamination of these vegetables [7]. Bacteria can be present in low numbers as a result of the uptake of water through certain irrigation or washing procedures or contaminated with human pathogens. Vegetables can become contaminated while growing in fields or during harvesting, handling processing, distribution and use [8]. The increasing use of waste water for irrigation have prompted a series of literature reviews and investigations into the global extent of waste water re-

use and its association with human health risk. The infection can also be a house hold affair where infected children or person provide the chief source of soil contamination by their promiscuous defecation in the soils[9].

The climate and vegetation of Karu LGA are suitable for the cultivation of Vegetables, using rain during wet season and irrigation during which water is derived from two sources, streams and ponds during dry season. It is a known fact that the use of execrate polluted irrigation water is a health risk to farmers and consumers of crops so produced. Raw waste water frequently contains high number of eggs of human intestinal nematodes where night soil is extensively used as fertilizers or waste water re-use is practiced[7].

This work is designed to detect the human intestinal parasites that improperly washed vegetables contain and ways in which they could be controlled. More and more people are concerned these days about the presence of parasites of medical importance in fresh vegetables. According to the numerous studies nearly 80.9% Nigerians in the north have intestinal parasites in their body[10]. Intestinal parasitic helminthes and protozoa infections are among the most common infections world-wide. In spite of the fact that the mortality rate among these infections is rather low in the case of *Ascaris lumbricoides* two per 1,000,000 people due to the high prevalence, these infections are regarded as a serious public health problem [11].

Research studies have demonstrated that drinking water is an important vehicle for transmission in underdeveloped cities when there is a breakdown in a water purification or cross contamination between sewage and drinking water pipes [12]. Food borne transmission is often due to handler and also occurs when produce is freshened or crops are irrigated with contaminated water which in short term leads to diseases and in long term can lead to massive deterioration of health [9].

Vegetables
Vegetables are parts of plants that are consumed by humans or other animals `as food .The original meaning is still commonly used as applied to plants collectively to refer to all edible plants, including the flowers, fruits, stems, leaves, roots, and seeds. Vegetables, like fruits contain fats and are low in calories but contain good amounts of minerals. All green vegetables are rich sources of fibres, calcium, magnesium, potassium, iron, beta-carotene, vitamin B-complex, vitamin C, vitamin A and vitamin K. Vegetables also contain many antioxidants. These health benefiting phyto-chemicals compounds firstly help protect the human body from oxidant stress, diseases, and cancers. Secondly, help the body develop the capacity to fight against these by boosting immunity [13].

Incidence of Water Borne Disease with Special Emphasis on Re-use of Waste Water in Agriculture
The use of contaminated water has caused some incidence of water borne diseases in Nigeria [14]. in Jos, Plateau State, Nigeria worked on 120 samples each of various vegetables crops such as lettuce, spinach, and cabbage. The result showed that varying amounts of viable eggs of Ascaris, *Trichuris* were recovered in about 100 gram of the various vegetables, hence, the need to enforce the use of treatment technology which can produce high level of parasite, bacterial and viral removal from waste water used to irrigate vegetables farmlands. In Africa, the growing demand for fresh and perishable agricultural produce in the major cities is deriving the development of pre-urban agriculture. Recycling solid waste and waste water into Petri-urban horticultural production contribute to cleaning the environment. However, this is associated with potential health risk which calls for careful agronomic practices including water quality and waste water management [15].

Indicator Organisms
Faecal coliform and faecal streptococcus are the conventional indication of faecal pollution of water is used [16]. Some more reliable indicator organisms of faecal pollution are *coliphageya, clisotridium per fringes* and *bitido bacteria* [17]. They are present in greater numbers than any pathogen, yet are unable to proliferate in water to any extent. Moreover, they should be more resistant than other pathogen to the stress of the aquatic environment and disinfection process [18]. As a result of this difficulty, for direct search for pathogens in water, microbiologist have evolved simple and rapid test for the detection of normal intestinal organism known as faecal indicator organisms, which account for the highest source of pollution especially in developing countries like Nigeria. The organisms used as indicators are *Escherichia. Coli, Enterococcus faecal, Salmonella Species, Bifid bacteria, Vibrio Cholerae.* The most widely used are coliforms bacteria.

Importance of Cleaning and Sanitation of Vegetables
Clean, well designed and maintained equipment is less likely to cause damage to fresh produce and to introduce spillage and pathogenic microorganism [19]. And keeping the harvested vegetables under controlled environmental conditions will help retard growth of post-harvest spoilage [19] and pathogenic microorganisms. Adequate post-harvest treatment of vegetables including handling, storage, Transportation and cleaning helps to reduce cross contamination of the produce from other agricultural materials or from the workers. Environmental conditions and transportation time will also influence the hygienic quality of the produce prior to processing or consumption. The presence of cut or damaged surface provides an opportunity for contamination and growth of microorganism and ingress into the plant tissue [20]. Washing of vegetables remove most of the adhering soil and dirt, hence, it should be recognized that false washing may also be a source of microbial contamination so should be done properly [21].

METHODOLOGY
Study Area
This research was conducted at Masaka Market. Masaka is a town in Nasarawa state of Nigeria, which lies between latitude 9° 0`North and longitude 7°40`East central Nigeria, It is a district of Karu Local Government Area, Nasarawa State, it is among the towns that form the karu urban area, a conurbation of towns under Karu Local Government Area of Nasarawa

State .Karu is in close proximity to the Federal capital Territory of Nigeria. It has an area of 2,640km². Karu local government has its headquarters in New Karu town, it was originally built to house the capital's civil servants and lower income families, but had no running or good sanitation system [21].
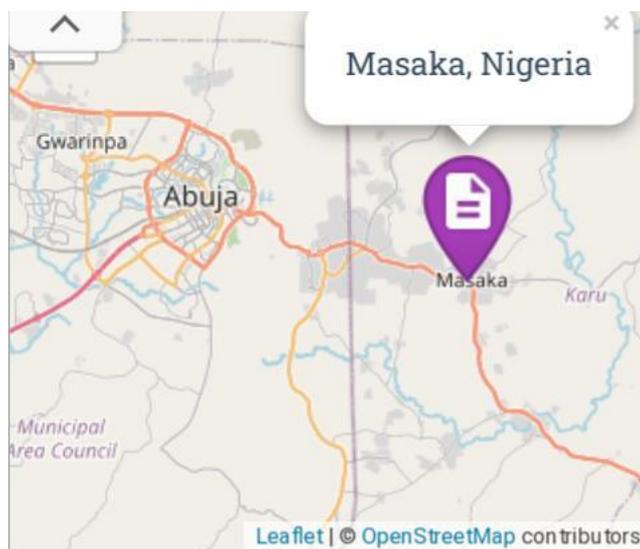

Fig 5: Map of Nigeria showing the location of Masaka Sample Collection

Fifty samples of green leafy vegetables were collected which included as Fluted pumpkin leaf (*Telfairia occidentallis*), Water leaf (*Hydrophyllum triangulare*), Lettuce(*Lactuca sativa*), Spinach (*Amaranthus hybridus*), Garden egg leaf (*Solanum aethiopicum*), False cubeb leaf(*Piper guineense*), Curry leaf (*Murraya koenigii*), Sorrel leaf (*Rumex acetosa*), Cabbage (*Brassica oleracea var. capitata*) and Scent leaf (*Ocimun gratissimum*) were purchased from Masaka market twice a week for a period of two weeks, upon collection each sample was placed in a separate zip-lock bag which had been properly labeled after which it was transported to the microbiology laboratory of Bingham university, K` Karu, Nasarawa state, where it would be assessed parasitological in the time range of 24 hours.

Sample Size
A total of Two-hundred samples of green leafy vegetables were used for this research.

Sampling Process
100g of the vegetable sample was weighed and washed separately for two minutes in beakers containing 250ml of distilled water and normal saline (0.90% NaCl) each for detaching the parasitic stages (ova, larva, cysts, and oocysts) commonly assumed to be associated with vegetable contamination. Samples were washed vigorously by shaking and vegetables were removed and discarded into waste bins. 10ml of the washed sample was sieved using fine guaze into 10ml centrifuge tube and centrifuged at 3000rpm for five minutes using a centrifuge [22]. Supernatant was decanted and sediment were stained with lugol's iodine and examined under light microscope under 10x and 40x objective lens respectively. Intestinal parasites were identified using techniques described by [23].

Statistical Analysis
Data analysis was carried out by Chi square test to find out the association between the parasites present in green leafy vegetables and type of parasites and to check the significance between the type of contaminated parasite and type of green leafy vegetables.

RESULTS
Table 1 shows the parasites present and the poly-parasite contamination with Fluted pumpkin leaf and Garden egg leaf having the same poly-parasite contamination.

Table 2 shows *Hookworm* (34.5%) as the highest amount of parasites followed by *Taenia spp* (31.69%), *Entameoba histolytica* (15.49), *Trichuris trichura* (9.86%) and *Ascaris lumbriocoides* (8.45%) with the least amount of parasite.

Table 3 shows the number of samples contaminated and the percentage of each parasite present in various samples with false cubeb leaf having the highest positive contamination with 100% and scent leaf having the lowest with 40%.

Table 4 shows the type of parasitic contamination according to type of vegetable with fluted pumpkin leaf being the highest with a total of 23 parasites present and scent leaf being the lowest with a total of 8 parasites present.

Table 1: Parasites present and Poly-parasites contamination of Green leafy vegetables

Parasites	F_1	W	S_1	L	S_2	F_2	C_1	S_3	C_2	G
Hookworm	+	+	+	+	+	+	+	+	+	+
Trichuris trichura	+	-	-	-	+	-	-	-	-	+
Teania spp	+	-	+	-	+	+	-	+	+	+
Entameoba histolytica	-	+	-	+	-	-	+	-	-	-
Ascaris lumbricoides	+	+	-	-	-	-	+	-	-	+

Key; F_1- Fluted pumpkin leaf, W- Waterleaf, S_1- Scent leaf, L- Lettuce, S_2-Spinach, F_2-False cubeb leaf, C_1-Cabbage, S_3-Sorrel leaf, C_2-Curry leaf, G-Garden egg leaf. + = Present; - = Absent

Table 2: Distribution of intestinal parasites in green leafy vegetables sold at Masaka market

Detected parasite	Frequency	Prevalence (%)
Hookworm	49	34.5
Trichuris trichura	14	9.86
Taenia spp	45	31.69
Entameoba histolytica	22	15.49
Ascaris lumbricoides	12	8.45
TOTAL	142	99.99

Table 3: Prevalence of parasites assessed in green leafy vegetables at Masaka market

Vegetables	Sample No.	Positive (%)	Negative (%)	X_2	P value
Fluted pumpkin leaf	20	15(75%)	5(25%)		
Waterleaf	20	12(60%)	8(40%)		
Scent leaf	20	8(40%)	12(60%)		
Lettuce	20	12(60%)	8(40%)		
Spinach	20	15(75%)	5(25%)	50.000	0.002
False cubeb leaf	20	20(100%)	0(0%)		
Cabbage	20	10(50%)	10(50%)		
Sorrel leaf	20	17(85%)	3(15%)		
Curry leaf	20	12(60%)	8(40%)		
Garden egg leaf	20	10(50%)	10(50%)		
TOTAL=	200	129(64.5%)	71(35.5%)		
X^2= 50.000	df =25				

***P-value*=0.002; the result is significant at *p*>0.00**

Table 4: Type of parasitic contamination according to type of vegetable

Vegetables	H	T_1	T_2	E	A	TOTAL
Fluted pumpkin leaf	6	5	7	0	5	23
Waterleaf	5	0	0	7	3	15
Scent leaf	3	0	5	0	0	8
Lettuce	5	0	0	8	0	13
Spinach	5	4	6	0	0	15
False cubeb leaf	7	0	7	0	0	14
Cabbage	5	0	0	7	2	14
Sorrel leaf	5	0	6	0	0	11
Curry leaf	5	0	7	0	0	12
Garden egg leaf	3	5	7	0	2	17
TOTAL	49	14	45	22	12	142

Key: H- *Hookworm*; T_1- *Trichuris trichura;* T_2- *Taenia* spp.; E- *Entameoba histolytica;* A- *Ascaris lumbricoides.*
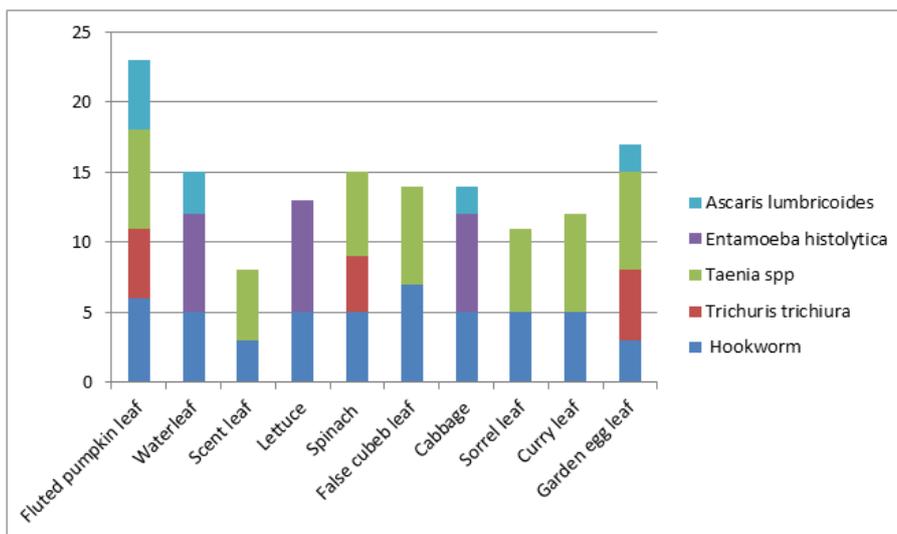
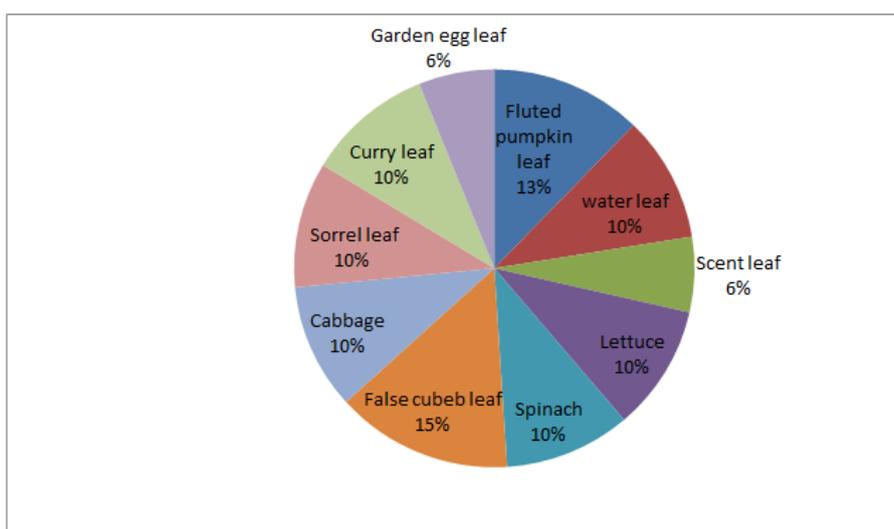**Fig 6: Bar chart showing type of parasitic contamination according to type of vegetables**

Fig 7: Pie chart showing Prevalence rate of *Hookworm* in vegetables sold at masaka market
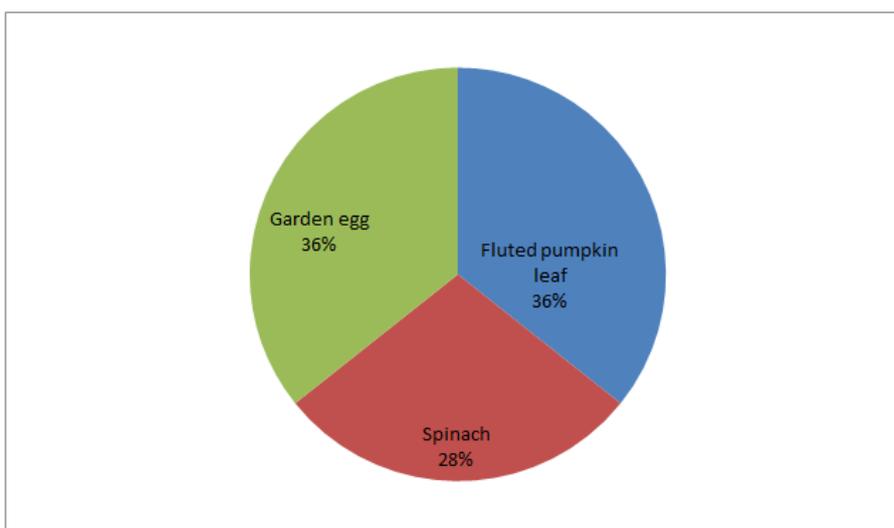

Fig 8: Pie chart showing Prevalence rate of *Trichuris trichura* in vegetables sold at masaka market
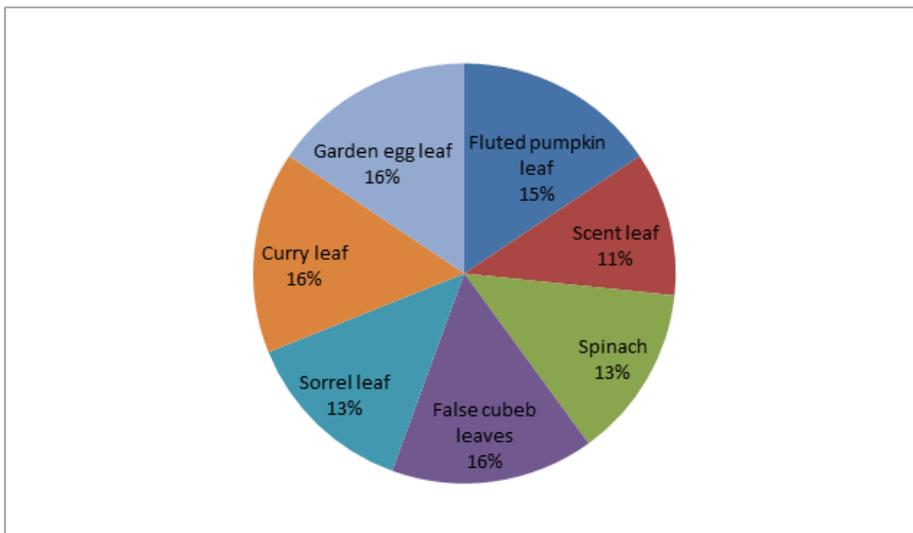
Fig 9: Pie chart showing Prevalence rate of *Taenia spp.* in vegetables sold at masaka market
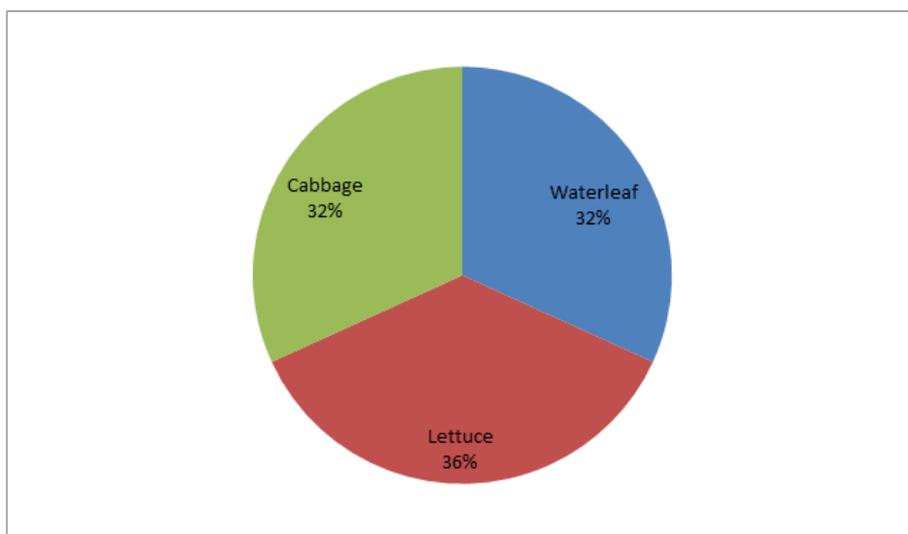

Fig 10: Pie chart showing Prevalence rate of *Entameoba histolytica* in vegetables sold at masaka market
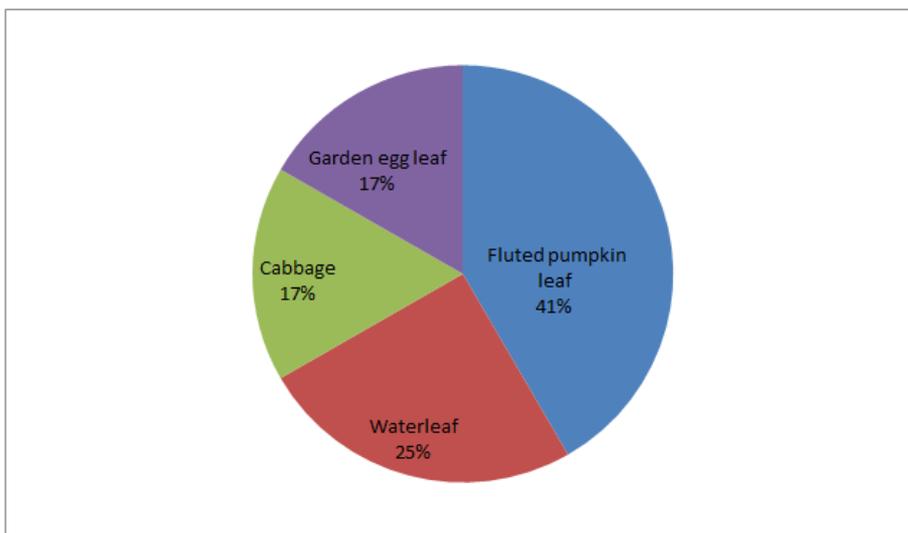

Fig 11: Pie chart showing Prevalence of *Ascaris lumbricoides* present in vegetables sold at masaka market

Fig 12: Larvae of *Hookworm*

Fig 13: Ova of *Entameoba histolytica*
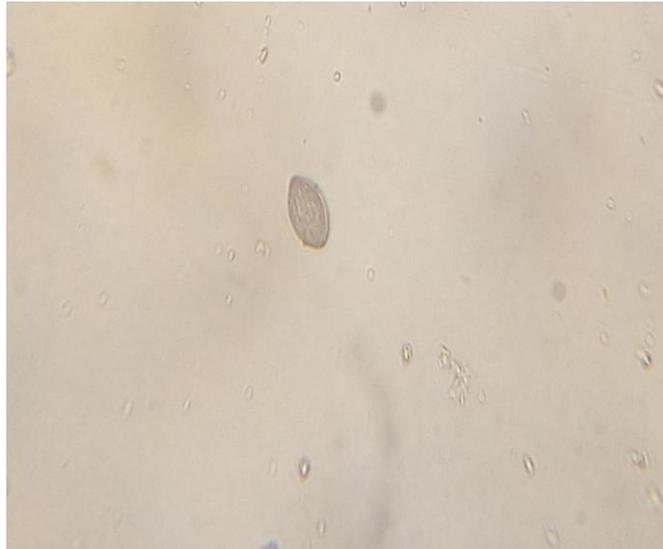

Fig 14: *Teania spp*
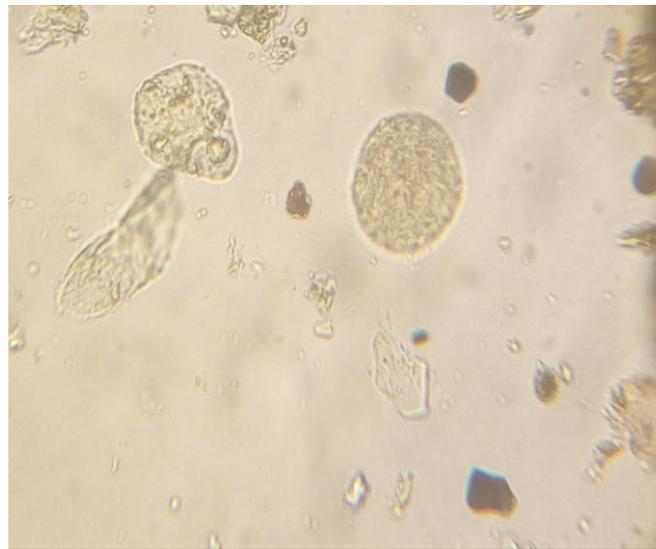
Fig 15: Ova of *Trichuris trichura*

Fig 16: Ova of *Ascaris lumbricoides*

DISCUSSION

This study showed a considerably high level of intestinal parasites contamination of Green leafy vegetables sold at Masaka market, Karu, Of the 200 samples of green leafy vegetables that were collected, processed and examined, 127 of them were contaminated with parasites and the overall prevalence of parasitic contamination was 64.5%. Contamination may have resulted from contaminated manure, manure compost, sewage sludge, irrigation water, runoff water from livestock operations or directly from wild and domestic animals. These potential contamination events are all plausible and consistent with the assumption that the level of contamination must have been high [24]. The overall prevalence of 64.5 % recorded in this study is higher than 36% recorded in Jos, Plateau state by Damen *et al*., (2007) [25], 20% Akyala *et al.,* (2013) [26] in Alhamis Lafia Nasarawa State, 14% by Umoh *et al*. (2001) [27] in Kaduna and Zaria, 33% by Oranusi *et al.,* (2012) [28] in Owerri, Imo State and 11% in

Zamfara by Shehu and Amina, (2014) [29], all in Nigeria. The prevalence was also higher than 20.1% by Takayanagui *et al*., (2002) [30] in Brazil, 29% by Uga *et al*., (2009) [31] in Vietnam and 31.7% by Doaa and Said (2012) [32] on green vegetables foodstuff in Alexandria, Egypt. However, prevalence of the present study was lower than 65.8% by Amaechi *et al.,* (2011) [33] in Owerri. However, the result was comparable to 64% recorded by Kenneth and Nsima (2002) [33], in Uyo, Akwa Ibom. Differences could have arisen from several factors which may include, geographical location, type and number of samples examined, methods used for detection of the intestinal parasites, type of water used for and post-harvesting handling methods of such vegetables which are different from country to another.

In table 3, it was made obvious that Fluted pumpkin, false cubeb leaf, sorrel leaf, water leaf, spinach, lettuce and cabbage were more contaminated

than curry leaf, scent leaf and Garden egg leaf. Low growth vegetables seem to be more exposed to contamination with parasite stages during high rainfall and floods unlike high growth vegetables. False cubeb leaf, Cabbage, lettuce and fluted pumpkin are short growth plants. This tendency of growing near the soil and trailing on the soil predispose them to contamination with various types of parasites which normally undergo part of their development in the soil. The contamination can also come from manure used for cultivation of these vegetables. These low growth vegetables tend to come in contact with applied manure in the soil since they are close to the ground and the manure can be compost or animal manure containing fecal material of animals like poultry, pig, cow and goat.

The higher contamination found in fluted pumpkin and false cubeb leaf may also be attributed to the shape and surface of these vegetables. The leaf folds of green leafy vegetables such as fluted pumpkin, scent leaf and false cubeb leaf have uneven surfaces that make parasitic eggs and cysts attach to the surface more easily, either in the farm or when washed with contaminated water. They could also retain dirts which may not be easily removed by slight washing and these dirts most times harbor parasite eggs and cysts. This may indicate why contamination is higher in leafy vegetables than root vegetables (Damen *et al*., 2007). This agrees with the findings of Damen *et al*., (2007) and Doaa and Said (2012), who recorded highest parasite contamination in leafy vegetables in Jos, Plateau state, Nigeria and Alexandria, Egypt respectively.

The use of sewage contaminated water for irrigation of vegetables is a common practice in developing countries including Nigeria where Karu is located. The water contaminated with wastes may not be treated before being used for irrigation. Vegetables may not only contaminate in the farm, but also from unclean environment in the markets as well as from vegetable vendors due to their poor sanitary status.

Vendors serve as intermediary between the producer farmers and the final consumers, they play an important role in the distribution chain of fruits and vegetable produces and also on the contamination and distribution of the contaminants bb [28]. Some vendors display their goods on the road side exposed to dust, flies and other insects. This practice coupled with the handling of the vegetables by different customers during bargain can contribute to contamination of vegetables [28]. Flies like housefly can easily carry parasite eggs and cysts from these dumped refuse in the filthy market premises and surroundings and transfer them mechanically to already displayed vegetables.

In table 1, it was noticed that Fluted pumpkin leaf and garden egg leaf has the same poly-parasite

contamination of *Hookworm*, *Teania spp*, *Trichuris trichura* and *Ascaris lumbricoides*. This can be related to the ability of the parasite to survive for days to months in the environment after being passed out in feaces.

In table 2, *Hookworm* had the highest occurrence followed by *Teania spp*, *E. histolytica*, *Trichuris trichura* while *Ascaris lumbricoides* the least. The presence of helminthes eggs in different vegetables is mainly related to contamination of soil rather than contamination of irrigating water. It must be noted that some of these vegetables are cultivated in the tropics and tropical climate provides a conducive atmosphere for the development of these parasites. Biologically, the highest health risk is found in helminthes infections compared with other pathogens because helminthes persist for longer periods in the environment and the infective dose is small.

In table 3, the number of samples contaminated and the percentage of each parasite present in various samples with false cubeb leaf having the highest positive contamination with 100% and scent leaf having the lowest with 40%. Data analysis was carried out by Chi square test the value was gotten to be 50.000 with df of 25. The P value was gotten to be 0.02 which means the 2 variables are associated with each other, which is less than 0.05 which proved the alternate hypothesis to be accepted, which means that the exact type of parasites present as contaminants of vegetables sold for consumption were determined and the parasitic load of contaminants present were also determined. In table 4, it was noticed that fluted pumpkin leaf had the highest amount of parasites with a total of 23 parasites while scent leaf had the lowest with a total of 8 parasites present.

CONCLUSION
The findings of the present study revealed the poor socio-economic condition, as well as poor sanitation practices in our environment. The presence of these parasites in the local vegetables meant for consumption might be due to lack of modern toilet facilities, inadequate public health enlightenment and ignorance that make people defecate indiscriminately resulting in pollution of water and farmland. There is dire need for the improvement of sanitary facilities in our markets and among vegetable vendors. There should be proper treatment of wastewater used for irrigation of vegetables, enlightenment campaign, environmental and friendly policies by government, sanitation laws; therefore, local market water and environment authorities have major roles to play. Researches should be done on edible vegetables sold in other markets of Nigeria to ascertain the hygienic status of the vegetables the citizens consume on daily basis. Combination of these results will help in policy making

on good sanitary system that will govern the environment

RECOMMENDATION

With increasing urban population, and the awareness of the nutritional content and importance of Green leafy vegetables, the following measures are recommended;

1. Practical, simple and inexpensive methods of improving the microbial quality of irrigation water at the farm level should be developed or an alternative source of water be provided for irrigation.
2. Farmers should be encouraged to use Personal Protective Equipment such as gloves, boots, trousers and long sleeve shirts during farm work to reduce the level of exposure.
3. Education on the right methods for vegetable washing especially at the point of consumption should be increased by the Ministry of health.
4. Vendors of these vegetables should ensure proper hygiene in handling and sale of these vegetables to reduce levels of contamination and exposure
5. Public awareness on effects of consumption of vegetables contaminated with these parasites should be done in other to educate the public on the health risks involved.

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