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UNICROSS JOURNAL OF SCIENCE AND TECHNOLOGY, UJOST

RESEARCH ARTICLE VOL. 2(2) SEPTEMBER, 2023 ISSN:2814-2233

Date Accepted 30th September, 2023 Pages 47 - 60

PREVALENCE OF PARASITES AND BACTERIA CONTAMINANTS ON FRESH VEGETABLES SOLD AT SELECTED MARKET IN ADO-ODO/OTA LOCAL GOVERNMENT AREA, OGUN STATE.

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Abstract

Ingestion of contaminated raw vegetables represents an important means of transmission of human pathogens. This study investigated the prevalence of certain parasites and the bacteria load of 100 fresh vegetables sold at four randomly selected markets in Ado-Odo/Ota Local Government Area. The vegetable samples comprise: 20 each of carrot (*Daucuscarrota),* ewedu (*Corchorusolitorius),* pumpkin (*Telfairiaoccidentalis),* shoko (*Celosia argentia)* and okro (*Abelmoschusesulentus).* Parasitological examination was carried out using sedimentation technique while the microbial load was analyzed by standard plate count. Overall prevalence of contamination is 60.0%, Shoko (75%), Okro (60.0%), Pumpkin (60.0%), Ewedu (55.0%), and Carrot (50.0%). All contaminated vegetables had either the eggs or the larva of *Entamoeba histolytica,* followed by *Ascaris lumbricoides, Trichuris trichuria, Toxoplasma gondii. Ancyclostom aduodenale* and and *Giardia lamblia,* which had the least distribution. Lusada market (72.0%) had the highest prevalence of infection while Ota market (52.0%) had the least prevalence. The Microbial load ranged from 1.0 x 10^{6}–3.5 x 10^{7}cfu/ml. *Escherichia coli* have the highest number of frequency of occurrence followed (37.9%), followed by *Staphylococcus spp* (19.5%), then *Klebsiellaspp* (14.94%), *Salmonella spp*(9.20%), *Shigellaspp* (6.90%) and *Pseudomonas spp* (1.15%) in that order. There was a significant difference between pumpkin, shoko, okro, ewedu and rate of contamination p <0.025). Vegetable handlers should be educated by health workers on effects of good hygiene on their products and community

Key Words: Prevalence, Vegetables, Bacteria load, Parasites and Ado-Odo/Ota

1.0 Introduction

Fresh vegetables are regarded as important components of a healthy and balanced diet and are essential for human health and well-being. Fresh vegetables are noted by consumers to be healthy and beneficial because of the deluge of scientifically approved and documented health benefits derived from consuming fresh vegetables. The regular consumption of vegetables in the

daily diet has been strongly associated to reduce the risk of certain cancer, stroke and cardiovascular diseases (Van duyn *et al.,* 2000). Consumption of contaminated vegetables has been associated with high cause of ill health and even eventual death. In 2006, spinach was attributed to be the major cause of a disease outbreak in the United State of America while blended salad leaves contaminated with *E. coli* 0157:H7 strain and *E. coli* 0157:H7 strain, was a source another disease outbreak in the United kingdom in 2016 accounting for the death of three persons. Consequently, fifteen individuals had a kind of renal failure known as hemolytic uremic syndrome [12] .

The means through which vegetables gets to the final consumers are possible routes of contamination (Ejike *et al.,* 2018). In the market, vegetables are usually displayed in open kiosks, shelves, sack bags and baskets were prospective buyers frequently handle them. Contaminated vegetables may be a potential source of infection. The hygienic-sanitary quality of vegetables is not based only on chemical safety (pesticide and hormone residues, heavy metals) but biological safety such as bacteria and parasites (Quynh Chau *et al.,* 2014). Bacteria, virus and parasites pathogens can be contaminants on vegetables (Behrouz *et al.,* 2014).

Intestinal parasitic infection is one of the leading problems facing developing and underdeveloped nations of the world at large (Wakid, 2009) with its negative impacts are seen in the health, economic, physical development and cognitive level of children and most especially immunocompromised individual (Tamirat *et al.,* 2014).

Protozoan cysts, worm eggs and larvae survive and develop in moist soil and environment of farm vegetables. These conditions are necessary for continuation of soil-transmitted parasite (STH) life cycle (Rai, 2008). Several surveys have been done in different parts of the world such as Syria (Alhabbal, 2015); Ghana(Duedu *et al.,* 2014); India (Sunil *et al.,* 2014); Pakistan (ul-Haq *et al.,* 2014); Iran (Nazemi, *et al.,* 2012); Nigeria (Idahosa, 2011) indicated that the vegetables can be a major source for transmitting protozoan cysts (*Entamoeba histolytica ; Giardia lamblia; Entamoeba coli; Balantidium coli*), oocysts (*Isospora belli ; Cryptosporidium spp.)* and helminthes' eggs and larvae (*Strongyloides stercoralis; Trichuris. trichiura; Enterobius vermicularis; Fasciola hepatica ; Ascaris lumbricoides ; Toxocara spp; Hymenolepis nana; Hymenolepis diminuta; Taenia spp.).*

The major health issue in developing and developed world arises from food and water-borne diseases (Siyadatpanah *et al*., 2013) Parasitic infections have led to about 300 million severe illness cases with approximately 200,000 deaths occurring in developing countries (Duedu *et al.,* 2014). Nigeria, like other developing countries is faced with the dilemma of inadequate disposal of excreta-related human wastes (Desalegn, 2017). Thus, in rural communities, defecation on open fields (farm land) is still a common practice. This practice enhances parasite populations on farm lands. The infection can also be a household affair where infected children or persons provide the chief source of soil contamination by their promiscuous defecation in the soils. The rate at which vegetables is being consumed in this community stimulates the concern of

ensuring that vegetables consumed are pathogen free, route of contaminants are monitored and education and awareness are communicated where necessary that will ensure standard procedures are maintained by sellers, handlers and consumers.

2.0 Materials and method

2.1 Study Area

The study was carried out in Ado-Odo Local Government Area, Ogun State. Ado-Odo Local Government Area is one of the 19 local government areas of Ogun State and it is the second largest in Ogun State. It came into existence on May 19, 1989, following the merging of Ota, part of the defunct Ifo/Ota Local Government with Ado-Odo/Igbesa Area and of the Yewa South Local Government. Its headquarters is at Ota , It lies on latitude 06° 41'00"N and longitude 03° 41'00"E with an area of 339 square miles and population of 526,565 at the 2006 census. Being primarily agrarian in nature, the local government area produces cash and food crops especially cocoa, kolanut palm oil, coffee, cassava, timber and vegetables.

The local government is populated mainly by the awori people, a subset of the Yoruba's and the original inhabitants of the area.

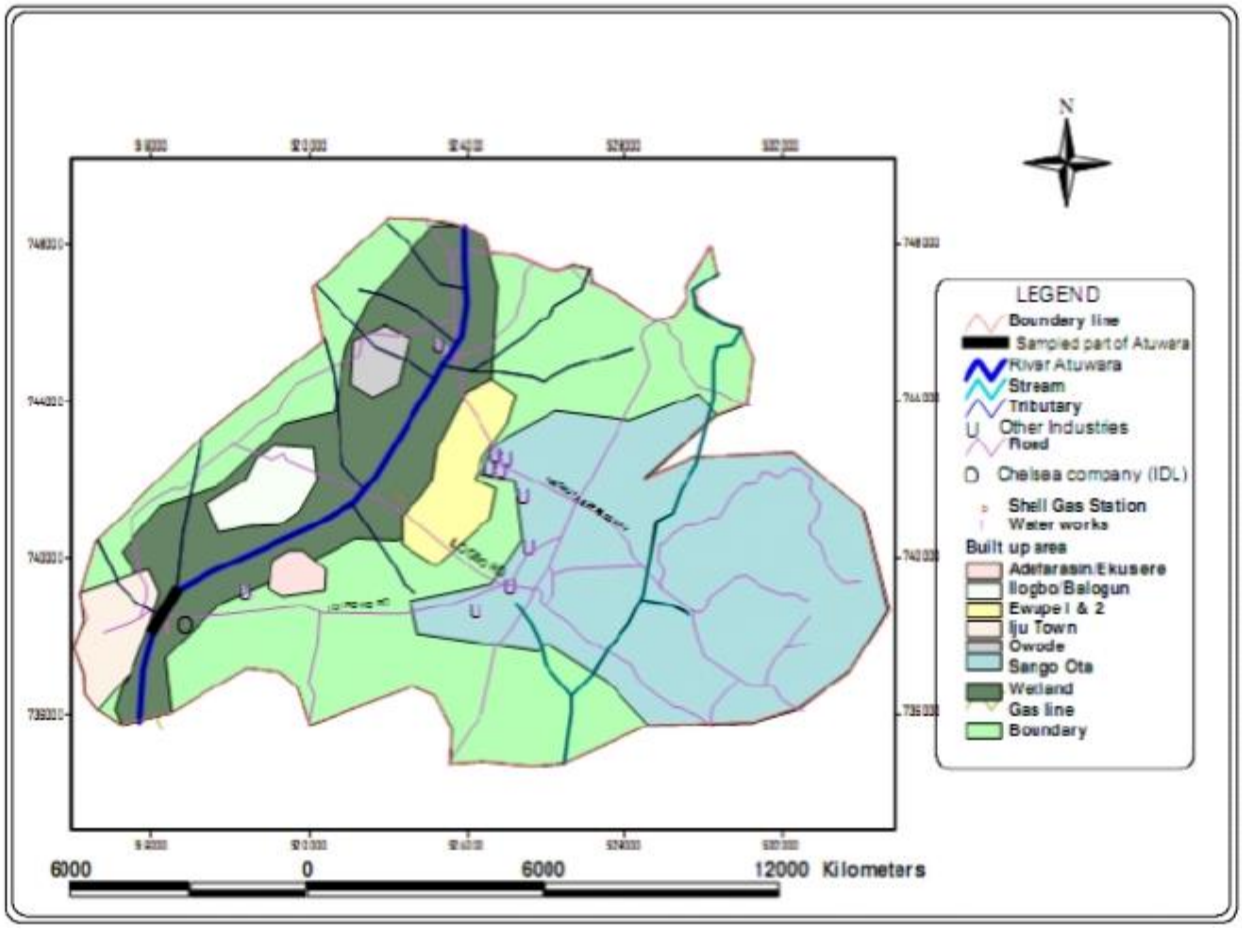

Fig 1: Map of Ado-Odo Local Government area

2.2 Sample collection

A cross-sectional study was used according to Damemen *et al.* (2007). A total of 100 fresh vegetable samples, comprising 20 sample each of carrot (*Daucus carrota),*ewedu (*Corchorus olitorius),*pumpkin (*Telfairia occidentalis),* shoko (*Celosia argentia)* and okro (*Abelmoschus esulentus)* were randomly purchased from retailers in four selected markets in the early morning between the hours of 8:00am and 10:00am. Samples were collected from different vendors in each market in order to determine the parasites and microbial load of vegetables sampled in the market mentioned above within a period of one month at two week interval. Each sample was placed in a separate sterile nylon bag and labelled appropriately and transported to the laboratory immediately for analysis.

2.3 Parasitological samples analysis

Collected vegetables were brought into the laboratory and weighed using the weighing balance and washed appropriately. 20g of each vegetables type was washed with 80ml normal saline solution (0.85% NaCl) in sterile beakers. It was left for 24 hours for sedimentation to take place. The top of the normal saline solution was then discarded carefully without shaking and the remaining 5ml washing normal saline solution was centrifuged at 300rpm for 15 min leaving the sediment in the test-tube.

2.4 Direct smear

A drop of the sediment was applied on the centre of a clean grease-free slide and gently covered with clean cover slip avoiding air bubbles and over flooding. The preparation was examined under the microscope using magnification of x10 and x40 objectives lens. The whole area under the cover slip was systematically screened for detection of parasites (egg, cyst and larva). This procedure was repeated until the sediment in each test tube was completely exhausted.

2.5 Iodine smear

A drop of the sediment was mixed with a drop of Lugol's iodine solution and examined as in direct smear for detection of parasite eggs, cysts and larva using x10, x40 and x100 objective lens. Identified was done using the key by Alhabbal (2015).

2.6 Microbiological sample analysis

One gram of each sample was homogenized with sterile de-ionized water using sterile mortal. 9ml of the prepared peptone water was pipetted into the different stock solution. The samples are in solid form, so therefore analytical unit was obtained by taking a portion from several locations within the sample unit and the prepared stock solution was agitated by hand mixing for 1minute before analysis.

2.7 Total colony count

Five tubes were filled with 9mls of peptone water each. 1ml from the stock culture was pipetted and transferred to the test tubes. 1ml from first test tube to the second, 1ml from the second to the third and 1ml from the third to the forth test tube until it got to the fifth test tube. 1ml of appropriate dilution was poured out from the fifth test tube. 0.1ml from the third and fifth test tube was poured into a sterile Petri-dish and Pour plate method was employed for the determination of microbial load of samples using nutrient agar. This was incubated at $37^{\circ}C$ for 24hrs and viable colonies present were counted using colony counter and recorded in cfu /ml.

2.8 Isolation of microorganisms

MacConkey Agar, Salmonella-Shigella agar, mannitol salt agar and Eosin methylene blue agar were prepared according to Manufacturer's instruction, and sterilized by autoclaving at 121°C for 15 min. Salmonella-Shigella agar, which does not require autoclaving, was sterilized by boiling for 15 min. The agars were inoculated by streak plating method from the nutrient agar. The viable colonies were counted. The predominant bacterial colonies were isolated from plate count agar by pour plate method according to Harrigan, (1998). Each colony was isolated in a pure form by sub culturing by streaking twice on the prepared differential agar and incubated at 37℃ for 24 hours for further studies and identification. The routine laboratory method of Cruickshank et al (1975) was used to characterize different isolated colonies. The isolated colonies were identified using their morphological characteristics and appearances on the differential agar.

2.9 Identification of microorganism

Microorganisms are identified by their cultural, morphological and biochemical properties and identified using Bergey's Manual of Determinative Bacteriology (Holt *et al.,* 1994).

Gram staining: The bacterial isolated from the plates were identified by gram staining. The colonies of microorganisms were picked from the growth of the cultured media plate and a smear of each of the bacterial isolates was made on a clean grease free slide. This was then heat fixed by passing the slide over the Bunsen burner through the interface between the blue flame and the yellow flame for three times. This process is to ensure that the bacterial isolates do not wash off during staining. Over- flaming which could cause the rupture of the bacteria was guarded. The surface of the smear was flooded with crystal violet solution which serves as a primary stain. This was washed thoroughly with water after 60 seconds and then the smear was flooded with lugol's iodine (mordant) for 30 seconds and then washed again with water. Then, the smear was decolorized with few drops of acetone 30 seconds and also washed off with water. It was observed that some bacteria retain the crystal violet even after treatment with an organic decolorizer such as acetone and alcohol and then stained with safranin washed off with water after 30second. The smear was allowed to dry and blotted using filter paper. A drop of oil immersion was added and viewed with x100 oil immersion objective lens in line with (Cheesbrough 2005). Gram positive bacteria stained blue violet in appearances while gram negative stained pink colour. Bacteria are classified as gram positive and gram negative. The gram negative bacteria lose the crystal violet after being dipped into the decolorizer, presumably because of higher lipid content of their cell wall and appear red or pink when observed in the microscope.

2.10 Data analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 16. P-values were calculated using Chi-square test appropriate. A P-value <0.05 was considered statistically significant.

2.0 **Result**

3.1 Parasitic contamination on vegetables sampled in the study area

A total number of 100 samples constituting five different types of vegetables were

examined for parasitic and microbial contamination. From the research work carried out, the rate of contamination of all the sampled vegetables was 60.0%. The rate of contamination of the sampled vegetables indicated that shoko (75%) had the highest rate of contamination as 15 out of 20 samples were contaminated with parasites. Okro and pumpkin have the second highest rate of contamination (60%) each followed by ewedu (55%) while carrot (50%) had the least rate of contamination. Statistical analysis indicated a significant difference between the rate of contamination and type of vegetables at p> 0.025 (Table 1).

Table 1: Parasitic contamination of vegetables sampled in the Study Area

Vegetable	No. examined	No. contaminated (%)	No. uncontaminated	P-value
Shoko	20	15 (75.00)	5 (25.00)	0.025
Carrot	20	10 (50.00)	10 (50.00)	1.000
Okro	20	12 (60.00)	8 (40.00)	0. .371
Ewedu	20	11 (55.00)	9 (45.00)	0.655
Pumpkin	20	12 (60.00)	8 (40.00)	0. .371
Total	**100**	**60 (60.00)**	**40 (40.00)**	

3.**2 The intensity of parasites on the vegetables sold in the four selected market**

It was observed that shoko at Atan (100%) had the highest rate of contamination, followed by Ota (80%), Lusada (60%) and Agbara (60%). While for Okro , Atan had (80%) followed by Lusada (80%), Agbara (80%) and Ota (60%). For Pumpkin Lusada had (80%), Agbara (80%) and Ota (80%). Ewedu at Lusada was (80%), followed by Atan (60%), Agbara (60%) While the Ewedu (20%) at Ota had the least rate of contamination. Carrot was (80%) at Ota , Lusada (60%) and Atan (60%) (Table 2).

Table 2: The intensity of parasites on the vegetables sold in the four selected market

	okro	punpkin	shoko	ewedu	carrot
Atan	5	5	5	5	5
% contaminated	4 (80.0)	ND	5 (100.0)	3 (60.0)	3 (60.0)
lusada	5	5	5	5	5
% contaminated	4 (80.0)	4 (80.0)	3 (60.0)	4 (80.0)	3 (60.0)
Agbara	5	5	5	5	5

% contaminated	4 (80.0)	4 (80.0)	3 (60.0)	3 (60.0)	ND
Ota	5	5	5	5	5
% contaminated	ND	4 (80.0)	4 (80.0)	1 (20.0)	4 (80.0)
Total	**12 (60.0)**	**12 (60.0)**	**15 (75.0)**	**11 (55.0)**	**10 (50.0)**

Key: ND= not determined

3.2 Parasites distribution in the 4 markets in the study area

The distribution of parasites in this research work on the different vegetable sampled, followed a particular trend. Overall, six parasites were identified from the vegetables sampled in the Study locations which were (*Entamoeba histolytica, Ancyclostoma duodenale, Giardia lamblia, Ascaris lumbricoides, Trichuris trichuria* and *Toxoplasma gondii*) All vegetables sampled were observed to be contaminated by the cyst of *Entamoeba histolytica,* Shoko was contaminated by five parasites (*Entamoeba histolytica, Giardia lamblia, Ascaris lumbricoides, Trichuris trichuria* and *Toxoplasma gondii*,) Okro and Pumpkin were contaminated by four parasites (*Entamoeba histolytica, Giardia lamblia, Ascaris lumbricoides* and *Trichuris trichuria*. Ewedu) was contaminated by four parasites (*Entamoeba histolytica, Ancyclostoma duodenale, Ascaris lumbricoides* and *Trichuris trichuria*) while Carrot was contaminated by two parasite. (*Entamoeba histolytica* and *Toxoplasma gondii*) (Table 3).

Table 3: Distribution of parasite species identified on different vegetable samples.

Parasites	okro	punpkin	shoko	ewedu	carrot
Egg of *Ascaris lumbricoides*	+	+	+	+	-
Larva of *Ancyclostoma duodenale*	-	-	-	+	-
Egg of *Trichuris trichuria*	+	+	+	+	-
Cyst of *Entamoeba histolytica*	+	+	+	+	+
Oocysts of *Toxoplasma gondii*	+	+	+	-	+
Cyst of *Giardia lamblia*	-	-	+	-	-

Key: +ve = present

–ve = absent

3.3 Prevalence of Parasites on Vegetables in the four different markets in the study population

From the research work, the prevalence of *Entamoeba histolytica* (51.66%),was the highest across all location which was isolated

in 31 out of 60 positive samples. The egg of *Ascaris lumbricoides* (38.33%), was the second highest isolated in 23 of 60 positive samples while *Trichuris trichuria* (18.33%) egg had 11 of 60 positive samples was isolated. *Toxoplasma gondii* (8.33%) which was 5 of 60 positive samples that was isolated. *Ancyclostoma duodenale* and *Giardia lamblia* 1 (1.66%) each from the positive samples and they had the least prevalence across all location sampled (Table 4). Egg of *Ascaris lumbricoides* and cyst of *Entamoeba histolytica* was present at all locations and the highest number at Lusada market. Larva of *Trichuris trichuria* was present in Lusada (12%) Ota (20%), Atan (12%). Oocyst of Toxoplasma gondii was present in Agbara (12%) and Lusada (2%). *Giardia lamblia* and *Ancyclostoma duodenale* is the least (1.67%), which are found in Lusada and Agbara market respectively (Table 4). From this research work, Lusada market has the highest prevalence of parasites (72%) followed by Agbara market (56%) then, Ota market (52%). While Atan market (60%) had the least prevalence of parasites (Table 4).

Table 4: Prevalence of parasitic contamination on vegetables

Parasite:	Agbara Market(25)	Lusada market (25)	Ota market(25)	Atan market (25)	Total
Ascaris egg	5 (20.00)	8 (32.00)	3 (12.00)	7 (28.00)	23 (38.33)
Ancyclostoma larva	1 (4.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (1.67)
Trichuris egg	0 (0.00)	3 (12.000)	5 (20.00)	3 (12.00)	11 (18.33)
Entamoeba cyst	8 (32.00)	10 (40.00)	8 (32.00)	5 (20.00)	31 (51.67)
Toxoplasma Oocyst	3 (12.00)	2 (8.00)	0 (0.00)	0 (0.00)	5 (8.33)
Giardia cyst	0 (0.00)	1(4.00)	0 (0.00)	0 (0.00)	1 (1.67)
Samples infected with:					
One parasite	11 (44.00)	14 (56.00)	11 (44.00)	15 (60.00)	51 (85.00)
Two parasite	3 (12.00)	2 (20.00)	1 (4.00)	0 (0.00)	6 (10.00)
Three parasite	0 (0.00)	2 (20.00)	1(20.00)	0 (0.00)	3 (5.00)
Total	**14 (56.00)**	**18 (72.00)**	**13 (52.00)**	**15 (60.00)**	**60 (100.00)**

3.4 Bacteriological analysis of fresh vegetables

In this research work, the fresh vegetables were analysed to assess the level of bacterial contamination. Almost all the vegetables sampled in this study were contaminated. From the sampled vegetables, the bacteria load varied with type of vegetables and the market (Table 4). For Agbara market, the Microbial load ranged from 2.0×10^{6}–3.5×10^{7} cfu/ml, 5×10^{6}– 2.8×10^{7} cfu/ml for Ota market, 3×10^{6}- 3.5×10^{7} cfu/ml for Lusada and 1×10^{6} – 3.0×10^{7} cfu/ml for Atan market Shoko from Lusada market and shoko from Agbara (3.5×10^{7} cfu/ml) each had the highest bacteria load while carrot from Atan

market had the lowest bacteria load (1 x 10^6 cfu/ml) of all the vegetables sampled. From the research work, twenty-two vegetables were contaminated at Lusada market, at Agbara market, twenty vegetables were contaminated, at Ota market, nineteen vegetables were contaminated while at Atan eighteen were contaminated.

From the research work, the total number of frequency was 78 (100%). *Escherichia spp* has the highest number of frequency (42.30%), *Staphylococcus spp* (21.79%), *Klebsiella spp* (16.67%), *Salmonella spp* (10.26%), *Shigella spp* (7.69%) while *Pseudomonas spp* (1.28%) has the least number of frequency

4.0 Discussion

The finding from this study showed the presence of the parasitic eggs of *Ascaris lumbricoides, Trichuris trichuria,* larvae of *Ancyclostoma duodenale*) and cyst of *Giadia lamblia, Toxoplasma gondii and Entamoeba histolytica*) on vegetables sold for public consumption in Ado-odo Local Government Area Ogun State. The findings from this research study presented similarities to previous research works (Ada *et al*.,2018).

This study which was done on 100 randomly selected vegetables surprisingly presented six genera of helminthes and protozoa parasites. The rate of contamination of vegetable was 60 (60.0%) which is slightly higher than the findings of previous research studies (Ada *et al*., 2018, Tchounga *et al.,*2017 and Damen, *et al*., 2007). Previous research works has related this usual increase in contamination to the use of animal and human wastes as manure, in growing vegetables. Recently (Simon-oke *et al.,* 2014) reported high rate of contamination of vegetables in Akure Metropolis Ondo State with value of 76.5% respectively.

In this study, among the parasites recovered, *Entamoeba histolytica* was the most prevalence parasite and it was distributed in all vegetables. *Entamoeba histolytica* were isolated and 51.67% was positive. Presence of Entamoeba *histolytica* in the vegetables is a sign of contamination with human feaces, hence the existence of intestinal pathogenic organisms in such vegetables is probable (Ada *et al.,* 2018). While cyst of *Giardia lamblia* and larva of *Ancyclostoma duodenale* are least common with 1.67% each.

In developing countries, *Giardia lamblia*, is widely spread enteric pathogen, is more prevalent than in developed ones (Musher & Musher, 2004). In this study *G. lamblia* cyst is only present in shoko sample contaminated in 6.6% contaminate which differ from the study on vegetables in Lahore (Shafa-ul-Haq *et al.,* 2014.) which showed 4.4% contamination with *Giardia* cysts. And also the findings of 21% by (Taherian, 2009).

Larvae of *Ancyclostoma duodenale* presence on ewedu and found only in Agbara market with a prevalence of (1.67%) agrees with the findings of (Said *et al.,* 2014.) who observed its presence in vegetables sold in some local markets in Port Harcourt, Nigeria.

The variations in the findings of parasitic contamination might be related to varying environmental conditions and hygiene practices of study areas. Defecation on farm soils by adult or children who are infected by these parasites, the use of organic manures as fertilizer during planting and poor personnel and domestic hygiene are factors aiding

development of parasites on soil and transmission to vegetables to humans and animals. Soil Transmitted Helminthes become infective in a favourable environment. This is similar to other findings. Personnel hygiene and sanitation also reflect on the microorganisms present in vegetable which might be due to the water use during cultivation, during harvesting, transportation, storage, and processing of the produce (Ray and Bhunia, 2007).

Although the population of parasites in each vegetable type varied, generally the rate of contamination was high in shoko (75%), okro (60%), Pumpkin (60%), and ewedu (55%) and carrot shows 50% of contamination in the present study. A similar result was reported by Hajjami *et al*. (2013), Damen *et al.* (2007) and Uneke (2007).

Ascaris lumbricoides is the largest round worm of human, is a soil transmitted parasite and the most widespread agent of the human infections with a prevalence of about 25% in world population (Northrop-Clewes and Shaw, 2000). The presence of *Ascaris lumbricoides* on some vegetables may promote childhood malnutrition and referred childhood growth haling (Omowaye, *et al.*, 2012). This work also agrees with findings from other parts of the world (Alhabbal, 2015 and Tchounga *et al.,* 2017) in Syria and Egypt respectively.

Egg of *Trichuris trichuria was* observed on most vegetables except in carrot. The total rate of prevalence is (18.33%). *Trichuris trichuria* has been stated to cause stunted growth even in moderately severe infections (Omowaye *et al.,* 2012).

The present study shows *Toxoplasma gondii* cyst in most of the vegetables except in ewedu vegetable with a low prevalence of 8.33% with the report obtained from (Al-Megrin, 2010) with low prevalence of 6.6% *Toxoplasma gondii* on vegetables, collected from markets of Riyadh, Saudi Arabia.

In this study, all the bacteria isolated have previously been isolated from vegetables in other studies, both in Nigeria and other countries (Tambekar and Mundhada, 2006; Uzeh *et al.,* 2009). The high bacteria counts observed from this study in the examined vegetables is similar to those obtained in other studies in Nigeria (Bukar *et al.,* 2010; Angela *et al.,* 2010). In this study, the slightly high contamination observed in the vegetables may be a reflection of water use during cultivation, the fertilizer used and the storage conditions. And it differs from the high microbial growth observed by (Angela *et al* 2010).

Some bacteria isolated are normal flora of soil and also normal flora of the vegetable (*Pseudomonas spp*) or are contaminants from soil, irrigation water, and the environment during transportation, washing water or handling by processors (Ofor *et al.*, 2009). *Staphylococcus spp.* especially *Staphylococcus auerus* are normal flora of human and are pathogenic organism of public health concern, and are presences in most of the samples opportunistic bacteria like *Salmonella spp.* and *Klebsiella spp.* are also present in some of the vegetables, further highlights the need to safeguard the health of the consumers by proper washing and decontamination of these produce which are consumed without heat treatment (Angela *et al* 2010). Vegetables should be

washed adequately before consumption either by the consumer in order to reduce the microbial load.

5.0 Conclusion

The research work carried out revealed the presence of several parasites and pathogenic bacteria on the vegetable sampled which indicated that vegetables consumed in Ado-Odo are contaminated with different parasites (larva, eggs, or cyst) and bacteria (opportunistic or pathogenic) which have public health problems both to children and adult. Personnel and hygiene measure are the most important criteria to control foodborne illnesses. In order to retain the nutrition value of vegetables, they are often eaten raw or with minimal heating and if contaminated with pathogenic bacteria and parasites, they may lead to health hazard. The result from this study also shows contamination of pathogenic parasites which are usually found in infected human feaces. Intestinal parasite *Entamoeba histolytica* was also found in the vegetable and was found to be the most prevalence and slightly high microbial load was obtained from the result. Hence, it is important to prevent the contamination of vegetables during the stages of cultivation, marketing and consumption through proper hygienic practices. From the findings, it is observed that for healthy consumption of vegetable to be maintained farmers should be encouraged to use disinfectants to treat vegetables before consumption help to remove the pathogenic organisms. Water and fertilizers used during cultivation vegetables should be supervised. Hazard Analysis and Critical Control Point (HACCP) principle should be implemented by the government to minimize and control the risk of microbial contamination. Proper personnel and sanitation hygiene should be maintained from point of harvest to poit of consumpt

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