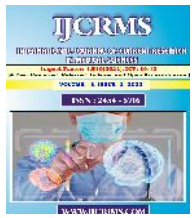
Int. J. Curr. Res. Med. Sci. (2022). 8(2): 39-51

International Journal of Current Research in Medical Sciences

ISSN: 2454-5716

(A Peer Reviewed, Indexed and Open Access Journal)

www.ijcrims.com



Original Research Article

Volume 8, Issue 2 -2022

DOI: http://dx.doi.org/10.22192/ijcrms.2022.08.02.003

Public health risks associated with fruits and vegetables at Owo markets

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Abstract

The steady growth of the urban population has brought more fruit and vegetable sellers in the market. These providers include a large number of people with little or no basic food safety knowledge and training. They are not properly trained and are not fully aware of the serious health risks posed by microbial contamination of goods. This study investigated the public health risks associated with eating fruits and vegetables sold in the major markets of Owo, Ondo, Nigeria. At owo, a total of 100 fruit and vegetable samples were collected from four major markets and analyzed using standard methods. The results of this study show that bacteria, fungi and parasites are found in fresh fruits and vegetables sold in the main markets of Owo, Ondo. Of the 100 fruit and vegetable samples surveyed, 89 (89.0%) were contaminated with bacteria, 79 (79.0%) were contaminated with fungi, and 59 (59.0%) were contaminated with parasites. The highest germ loading was recorded with chili peppers. Four parasites were identified in this study. These include Ascarislumbricoides, Entamoebahistolytica, Ancyclostomaduodenale, and Taeniaspp. The fungus isolated in this study is the genus Aspergillus. (30%), Candida albicans (37%) and Fusarium spp. The study found that fruits and vegetables sold in major markets were fairly heavily contaminated with bacteria, fungi, and parasites. These should be seen as potential risks for the community and traders.

Keywords: public health risks, fruits, vegetables, Owo markets

Introduction

Since the groundbreaking epidemiology of the 1850s, when British doctor John Snow discovered that cholera is transmitted through water, there has been a deep understanding of the transmission of various pathogens through drinking water and food. Diseases caused by eating such contaminated foods are known as food-borne diseases. In fact, food poisoning is a widespread problem involving over 200 pathogens, including bacteria, parasites, toxins and viruses. Despite efforts to study food poisoning, less than 50% of all causes have been identified, usually due to limited diagnostic options. From an epidemiological point of view, there are 47.8 million food-borne diseases (16,000 per 100,000 populations) annually in the United States (using Food Net data from 2000 to 2010), of which 9.4 million are 31. It is reported to have been identified by known people. The pathogen was caused (Scallan et al., 2011). Cultural and demographic factors, as well as lifestyle changes, have led to major epidemiological changes in food poisoning in recent years. Fruits and vegetables were a typical source of outbreaks, as the majority of the population buys fruits and vegetables in large urban markets (Argudín, 2010). Fruits and vegetables sold on the market are highly valued for their taste, availability, low cost, convenience and role in the cultural and social heritage of society (Nguendo, 2018). They also provide some nutrients to consumers, especially the low-income group in developing countries, and are important in maintaining the nutritional status of the population (Muzaffarand Mallik, 2019). However, due to unacceptable handling, it may be considered unsafe by market vendors. Vegetables are often associated with diarrheal disorders due to improper handling and delivery. In fact, the fruits and vegetables sold by market sellers are most often contaminated with pathogens and have since been reported to become a major public health problem (Guven et al., 2010; Al Mamun). et al., 2013).

From the initial contamination of raw fruits by pathogens in transit to the subsequent contamination by the sellers themselves in handling, storage and distribution, many are involved in investigating the dangers posed by fruits and vegetables sold on the market. Factors need to be considered (Al Mamunet al., 2013). In some cases, the environment poses a danger. Fruits and vegetables on the market pose a great health risk to public health due to the lack of basic infrastructure and services, and the large number of street sales that are difficult to manage due to their diversity, mobility and temporary nature. Bring. In short, many reports highlight the risks associated with eating contaminated fruits and vegetables in markets that contain high levels of enteric pathogens (Elobeid et al., 2014). Knowing the microbiological quality of fruits and vegetables sold on the market is an important factor in assessing related safety issues and assumes that the competent authority can respond appropriately, so vegetables and Measures to improve safety and hygiene in this economic sector will help to better understand the microbiological issues associated with them.

The aim of this study is to examine fruits and vegetables sold at Owo major market for microbial contamination.

Materials and Methods

Study Area

This study was conducted in Owo major markets, which lies on latitude $7^0$11’46.32’’N and a longitude of 5^0 35’12.25’’E Southwestern Nigeria (Adeleke *et al.*, 2012). Owo is a small city located in Ondo state with a population of 276,574, and the city is occupied by both elites and indigenous residents.

Sample Collections

A total of 100 samples of the fruits and vegetables were obtained from randomly selected spots in the three major markets, namely Oja Oba, OjaIkoko, Eyinogbe market, in Owo metropolis. The fruits are normally transported in cartons by the vendors far away from Southwestern Nigeria,the fruits and vegetables tested in this study was selected based on the factors of those that were eaten raw and their availability during the season of the year. The samples were collected into sterile containers and transported to the laboratory for analysis.

Sample Design

This study were carried out using field survey. The fruits and vegetable produce used in this study were collected from randomly selected fruits and vegetable vendors in four major markets in owo. Each produces were collected on interval of three to four days for 2-3 months.

Study Population

Wimmer *et al*. (2011) defined population as entire set whose characteristics are to be projected. The study population for this study is different fruits and vegetables sold at different spot in Owo major markets.

Study Duration

The duration for the completion of this study is 2-3 months.

Materials

Petridishes, Incubator, Autoclave, Binocular Microscope, Weighing balance, Hot air oven, Bunsen burner, Wireloop, Handgloves, slides, Coverslip, Candle jar, Measuring cylinder, Sterile Pasteur Pipettes, appropriate stains, Conical flasks, Normal saline, Chocolate agar and MacConkey agar, Sabouraud Dextrose Agar.

Microbial analysis

Isolation of Micro Organisms

The samples were washed with normal saline in 100 ml round bottom clean plastic containers. 0.01 ml of the sample were then taken from each container and cultured on MacConkey and chocolate agar plate using the spread plate method and were incubated overnight at 37°C. The diluted sample were cultured on Sabouraud's dextrose agar, using the spread plate method for the isolation of fungi and incubated at 25°C for 7days. (Adeleke *et al.,* 2012).

Bacteriological Analysis of Sample

The colonies were identified by standard bacteriological procedures as described by Cowan and Steel (1975). Pure colonies of bacteria were obtained by picking discrete colonies using a sterile wire loop.

Colonial Morphplogy

The shape, size, colour, pigmentation, elevation, edges and odour of the bacterial species were examined on the agar plates after appropriate incubation periods(Cowan and Steel,1998).

Gram Staining

Following the positive growth of culture on each agar plate, Gram staining were performed as a preliminary step in the initial classification of bacteria. These were done to differentiate organisms based on the structure of their cell walls as Gram positive (tough outer cell of peptidoglycan), or Gram negative (having two layers of membranes, with a thin layer of peptidoglycan sandwiched between them). The test organisms were heat-fixed on slides and flooded with crystal violet for about 60seconds and rinsed with water for about 5seconds. The stained slides were then flooded with iodine solution for about 60seconds and rinsed with water. Acetone was added as a decolourizer and rinsed with water afterwards. Finally, the stained slides were flooded with safranin for 120seconds rinsed with water, blotted dry, and viewed under a microscope. Gram-positive organisms appeared blue/purple under the microscope while Gram-negative organisms appeared red/pink. The cell shapes were viewed under this procedure Baron and Finegold (1999) and Chaichanawongsaroj *et al.* (2004).

Biochemical Analysis of sample

Series of biochemical tests such as motility test, catalase, indole test, coagulase, oxidase, and urease were performed on the bacteria isolates in accordance with procedures highlighted by Baron and Finegold (1990) and Chaichanawongsaroj *et al.* (2004)

a) Motility test: Chaichanawongsaroj *et al.*, (2004), These tests were done to differentiate motile from non-motile organisms. A sterile wire loop were used to inoculate a motility medium by making a stab to the bottom of the tube and afterwards incubated for 24-48 hours. If the organism is motile, the tube appeared cloudy, the organism spread out of the stab line. Non-motile organisms grew along the streak line only and the media was cloudy

b) Catalase test: These tests were carried out by putting a drop of hydrogen peroxide on a clean slide. With a sterile inoculating loop, a colony of organisms were picked and allowed to be in contact with the hydrogen peroxide. Presence of bubbles indicated positive reactions while absence of bubbles indicated negative reactions. Baron and Finegold (1990).

c) Oxidase test: A piece of papers were placed in a sterile petridish and 2-3 drops of freshly prepared oxidase reagent were added. Using a sterile glass rod, a colony of the test bacterium were picked and smeared on the filter paper and were observed for 10 seconds. The presence of blue-purple colour indicates a positive oxidase test while the absence of the blue-purple colour indicates a negative oxidase test. Baron and Finegold (1990).

d) Coagulase test: These tests were used to identify *Staphylococcus aureus* from other *Staphylococcus spp.,* which produces the coagulase enzyme that causes plasma to clot by converting fibrinogen to fibrin. A drop of sterile distilled water were placed on each end of a sterile dish. Chaichanawongsaroj *et al.,* (2004). A colony of the test organisms were emulsified on each spot to make two thick suspensions. A loop-full of plasma were added to one of the suspensions and mixed gently. The slides were examined for clumping or clotting of the organisms within 10 seconds.

e) Indole test : These test were used to determine the ability of an organism to split indole from the amino acid tryptophan using the enzyme tryptophanase. Baron and Finegold (1990). A colony from the plates were emulsified in a sterile peptone water and incubated overnight at 37^{o}C. After incubation, two drops of Kovac's reagent were added to the broths. For positive, a red ring were formed at the surface of the agar .

f) Urease test: These were used to determine the ability of an organism to split urea to form ammonia by the action of the enzyme urease. Media used for urease test contains a pH indicator, phenol red, which turns to pink at alkaline pH. Urea broth were inoculated with test organisms and incubated for 24hours. Intense pink/red colour indicates a positive test and yellow or no colour change indicates a negative result.

Mycological Analysis of Samples

The fungi isolates were identified by microscopic examination of the actively growing mould using morphological characters such as the absence or presence rhizoid, colour, and micro-morphology of their sporulating structures and conida (Evans and Richrdson, 1989)

Parasitological Analysis of Samples

The aliquots of the samples were placed in 100 ml of normal saline in round bottom clean plastic container and were allowed to stand on the bench for few hours to allow proper sedimentation in accordance with Alli *etal.* (2011). The supernatant were discarded with a Pasteur pipette leaving about 15 ml at the bottom. 10 ml of the deposit were transferred into a centrifuge tube and were spun for 5 min at 3,000 rpm. The supernatants were decanted, while the deposits were re-suspended with 10% formal saline and centrifuged. The supernatants were decanted and the deposits were transferred into a clean glass slide. A drop of iodine were added as stain and

covered with a cover slip. The slides were examined under ×400 microscope for parasite ova and cysts as previously described by Alli et al. (2011).

Procedure for Quantitative Estimation of Bacteria and Fungi isolated from Fruits and Vegetables Samples.

Quantitative analysis of bacteria and fungi isolated from fruits and vegetables were calculated using the Miles and Misra's Method since this method has been shown to be precise.

Materials

- A calibrated automatic pipette, delivering drops of 20µl.
- Petri dishes containing MacConkey agar and Sabouraud dextrose agar.
- Peptone water
- Bacterial suspension.

Method

- In a Pre-labelled container, the solution were serially diluted (1 in 10 dilution) by adding 900µl of peptone water and 100µl of undiluted of washings into a sterile container. (**Note**: Dilutions were made to at least 10^{-8} into a sterile container).
- The surface of the plates were sufficiently dry to allow a 20µl drop to be absorbed in 15–20 minutes.
- Plates were divided into equal sectors and the sectors will be labelled with the dilutions.
- In each sector, 20 µl of the serial diluted solution were dropped onto the surface of Sabouraud dextrose agar and MacConkey agar plates in duplicate and the drop were allowed to spread naturally.
- The plates were left upright on the bench to dry before inversion and incubated at 37^0C for 18 – 24 hours.
- Each sector were observed for growth and the colonies will be counted in the sector where the highest number of full-size discrete colonies can be seen (usually sectors containing between 2-20 colonies are counted).

Equation to calculate the number of colony forming units (CFU) per ml from the original aliquot is as follows:

- ✓ CFU per ml = Average number of colonies for a dilution x 50 x dilution factor.

Note: Colony-forming units were counted after overnight incubation at 37^oC and mean count of plates will be taken. The overall load of bacteria carried by each Fruits and Vegetables were counted.

Statistical Analysis of Data

The student t-test and Chi-square was used to determine the significant difference in the prevalence of the organisms and the microbial load between the markets using Statistical Package for Social Sciences (SPSS) version 23.0

Quantity of fruits and vegetables used

Fruits and vegetables	NO
Apple	10
Carrot	10
Onions	10
Orange	10
Tomatoe	10
Chillipepper	10
Green pepper	10
Cucumber	10
Water melon	10
Green leaf vegetables	10
Total	100

Results

Fruits and vegetables were gotten from four major market in owo Ondo State. A total of 100 samples were examined to check for their microbial contamination. Samples collected from the major markets were evenly distributed by collecting 10 samples each of the produces in total and 25 samples from each market.

Data collected were presented using tables and Bar-chats.

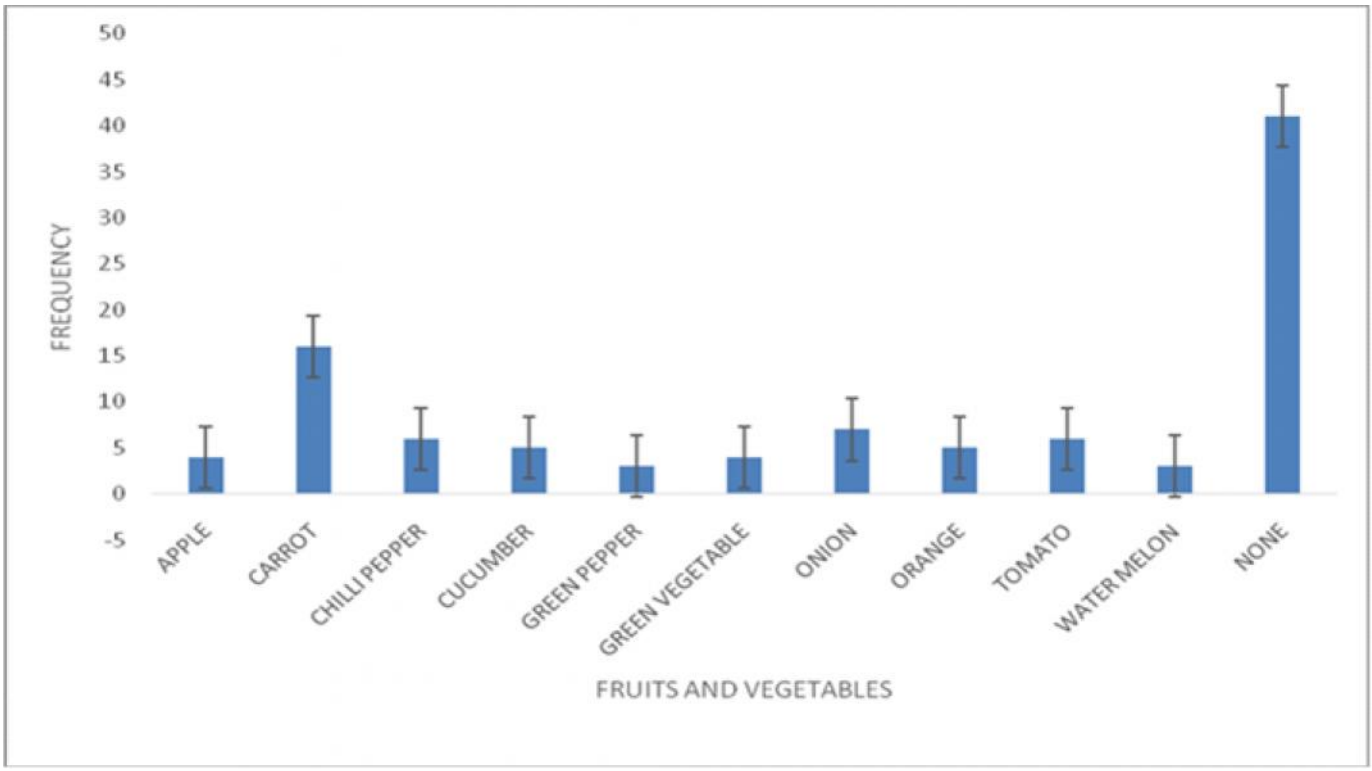

Figure 1: Bar chart showing the frequency of parasites detected in the fruits and vegetables

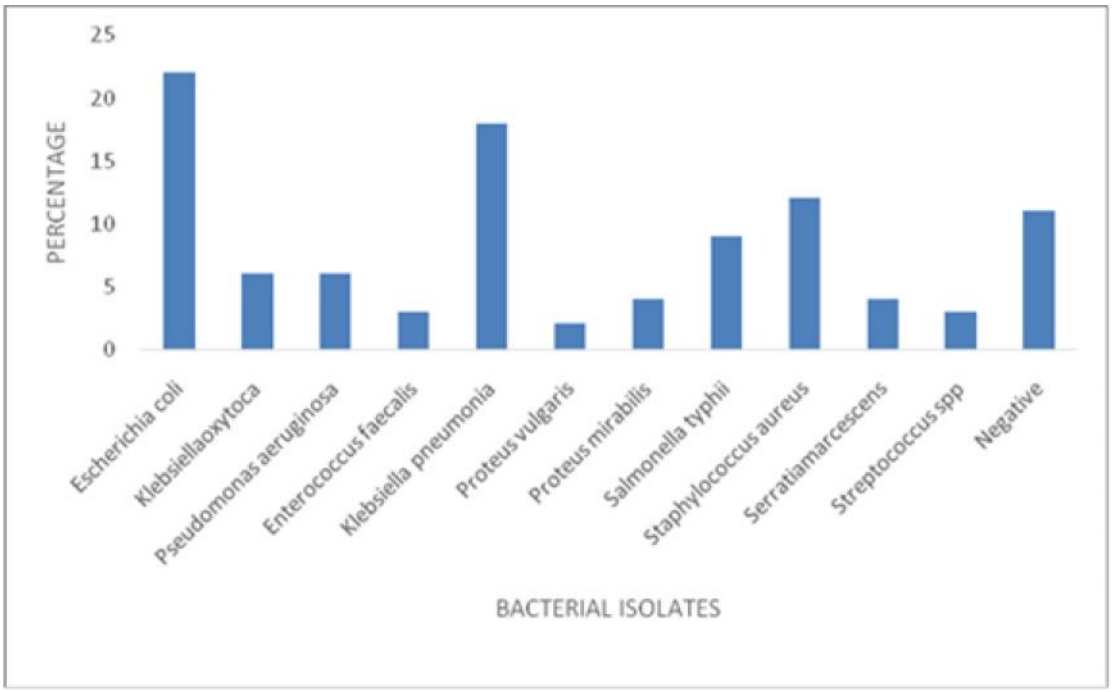

Figure 2: Bar chart showing the percentage of bacteria isolates in the fruits and vegetables collected

Table 1: Frequency of Fungi Isolate Depending on Type of Produces Sold at Local Markets of of Owo City (N=100)

Fungi Isolate	Apple	Carrot	Chilli pepper	Cucumber	Green pepper
Aspergilus spp.	0	5	3	3	2
Candida albicans	5	13	4	2	3
Fusarium spp.	2	4	3	0	0

Data are presented as absolute values
Where:
N = total number of fruits and vegetables collected

Table 2: Frequency of Fungi Isolate Depending on Type of Produces Sold at Local Markets of Owo City (N=100)

Fungi Isolate	Green vegetables	Onion	Orange	Tomato	Watermelon	Total n (%)
Aspergilus spp.	2	6	3	3	3	30 (30%)
Candida albicans	3	4	0	3	0	37 (37%)
Fusarium spp.	0	0	3	0	1	12 (12%)

Negative = 21 (21%)
Data are presented as absolute values with corresponding percentages in parentheses
Where: N = total number of fruits and vegetables collect

Table 3 : Pearson's correlation coefficients of the organisms isolated and count

Parameter	Bacteria isolate	Bacteria count (CFU/20ml)	Fungi count (CFU/20ml)	Fungi isolate	Parasite identified
Bacteria isolate	1	-0.343**	0.036	-0.015	-0.003
Bacteria count (CFU/20ml)		1	-0.134	0.022	-0.040
Fungi count (CFU/20ml)			1	-0.502**	-0.008
Fungi isolate				1	-0.013
Parasite identified					1

**. Correlation is significant at the 0.01 level (2-tailed).

The results shows the Pearson's correlation coefficients of the Bacteria isolated, Bacteria count, Fungi count, Fungi isolate and parasite identified in the fruits and vegetables collected in this study.

A negative correlation was observed between bacteria count and the bacteria isolates (r = -0.343, p<0.01). While no significant correlation was found between bacteria isolate and fungi count, fungi isolate and parasite identified.

A negative correlation was observed between fungi count and the fungi isolates (r = -0.502, p<0.01).While no significant correlation was found between fungi count and bacteria count, bacteria isolate and parasite identified.

Discussion

Parasitic contamination of fruits and vegetables has become a global public health and socio-economic problem, especially in developing countries. This is due to little attention paid to food poisoning in these countries. Deterioration of fruits and vegetables can be caused by physical damage and physiological deterioration due to the invasion of microorganisms (Kemajou et al., 2017). The results of this study show that bacteria, fungi and parasites are found in fresh fruits and vegetables sold in the main markets of Owo, Ondo. Of the 100 fruit and vegetable samples surveyed, 89 (89.0%) were contaminated with bacteria, 79 (79.0%) were contaminated with fungi, and 59 (59.0%) were contaminated with parasites. The microbiological quality of fruits and vegetables was investigated in the major markets of Owo, Ondo. Of the 100 fruit and vegetable samples analyzed, about 89 (89%) showed bacterial isolate growth, consistent with the report by (Kemajou et al., 2017).

Both Gram-negative and Gram-positive bacteria have been identified. The isolated organisms are Escherichia coli (22%), Klebsiella pneumonia (18%), Staphylococcus aureus (12%), Salmonella tifi (9%), Klebsiella oxytoka (6%), Pseudomonas aeruginosa (6%), Seratia Marsessens (4%), Proteus mirabilis (4%), Enterococcus faecalis (3%), Streptococcus spp (3%), Proteus vulgaris (2%).

The reasons for this high bacterial load are the inability to maintain basic hygiene during consumption, the lack of good quality water for cleaning and pre-sterilization of fresh fruits and vegetables in mass production, harvesting, transportation and storage, especially. Market exposure and reckless person-to-person interactions for sale. The frequency of gut microbiota isolated in this study was similar to that reported by Adequity in Nigeria (Oluyege and Famurewa, 2015; Oluboyo et al., 2019). Bacterial contamination of fruits and vegetables on the market can result from farmland, farm-to-market transportation, or marketer handling. The highest germ load was recorded with chili peppers. Since operating rooms are usually kept dirty, mutual contamination of fresh products can come from the seller or the surrounding area. The presence of intestinal parasite stages in fruits and vegetables indicates fecal contamination in humans and animals. Open defecation is also associated with constant fecal pollution of soil and drinking water as a factor in the unsanitary environment (Gboeloh and Sounyo; Adejayan and Morenikeji, 2015). The results of this study show that fresh fruits and vegetables sold in the main markets of Owo, Ondo, contain parasite eggs, cysts and larvae. Of the 100 fruit and vegetable samples surveyed, 59 (59.0%) were contaminated with parasites. Four parasites were identified in this study. These include Ascarislumbricoides, Entamoebahistolytica, Ancyclostomaduodenale, and Taeniaspp. These parasites are similar to those identified in the study (Malann and Tim, 2016; Auta et al., 2017; Bishop and Yohanna, 2018), and the prevalence of Ascaris lumbricoides is similar to this study. There are reports that it is expensive. Although high, the parasite contamination score ((59.0%) in this study is lower than the 85% rate (Mbata et al., 2017) reported in selected markets in Port Harcourt, but (Elom et al.). al., 2012) In Eboni, Katsina has a 45% pollution rate (Auta et al., 2017) and Abuja's Gwagwarada has a 42% pollution rate (Malann and Tim, 2016). These changes are the origin of fruits and vegetables (products), weather or environmental conditions. In this study, cucumbers had the highest overall prevalence of parasitic contamination (71.4%), but the results were (Akoma et al., 2017; Agbalaka et al., 2019) Jos and Lokoja. Reported that no parasite contamination was seen. In this study, parasites were detected in cucumbers, peppers and tomatoes. This pattern is inconsistent with the results of other researchers who reported the absence of parasites in leafy vegetables such as cucumbers, peppers and tomatoes (Adejayan and Morenikeji, 2015; Mohamed et al., 2016;). The detection of Entamoeba histolytica, the only protozoan in this study, is consistent with the results of (Benti and Gemechu, 2014) and (Obebe et al., 2020) in Nigeria and Ethiopia, respectively. The emergence of this protozoan cyst can be traced back to pre-harvest contamination of fresh vegetables from irrigation and sewage contaminated with human feces, or directly from

human feces (Obebe et al., 2020). Other parasites of public health concern, such as Giardia intestinalis and Cryptosporidium parvum, detected in previous studies (Hassan et al., 2012; Kudah et al., 2018) were not found in this study. Disagreements between this study and other studies include geological location, climate and environmental conditions, soil types, changes in rainfall and sample size, techniques used to detect parasites, improper handling, and society. It may be due to the difference in economic grade. Despite the differences in the isolated parasites, the eggs of Ascaris lumbricoides and the eggs of Ancyclostoma duodenale were common to all fruits and vegetables in the study. This may be because these parasites can withstand a variety of adverse environmental conditions and can serve as indicators of water pollution and water pollution due to indiscriminate defecation leading to farmland.

Prevalence of Entamoeba histolyticawas (23%). This result is higher than reported by the city of Bahir Dar (12.8%) and Desetown (24%) in northwestern Ethiopia (Hailemeskel et al., 2018), with carrots (39%) being the most polluted, followed by chili peppers (24%). 21.7.). %). Fluctuations in the prevalence of Entamoeba histolytica can be attributed to long survival and geographical distribution of cysts in cold and humid conditions. Klebsiella pneumonia and E. coli were both highest in carrots (27.7%). Outbreaks of Escherichia coli, Staphylococcus aureus, Salmonella typhii, and Enterococcus faecalis are a major public health concern as most of these microorganisms are toxic. Food poisoning is an increasing public health burden, social turmoil, preventable financial stress, and preventable death (Ajiboye and Emmanuel, 2021). The fungus isolated in this study is the genus Aspergillus. (30%), Candida albicans (37%) and Fusarium spp. (12%). The highest fungal load was recorded with bell peppers (Table 2). High isolation rates of fungal species from the fruits selected in this study have already been isolated in rotten fruits and vegetables in other studies in Nigeria (Mailafia et al., 2017, Jere et al., 2018). .. It is known to produce Aspergillus mycotoxins. Mycotoxins are secondary metabolites that are known to have many harmful effects when ingested by humans. Factors that influence mycotoxin production include fruits or vegetables and varieties, geographic location, climate, pre-harvest treatment, and harvesting methods (Jere et al., 2018). Non-pathogenic microorganisms have been found to increase spoilage rates, reduce product quality and reduce market value (Ajiboye and Emmanuel, 2021). Studies show that most soils and rivers in Nigeria are heavily contaminated with pathogens (Adeleke et al., 2012). These fruits should have been contaminated from the fields and the pathogens were carried to the storage room. Isolation of microbial isolates in feces and recovery of E. coli cysts and A. lumbricoides demonstrate fecal contamination of fruits by either the water used for irrigation or the soil of the growing area. On the other hand, poor post-defecation hygiene was also reported among Nigerians, and the tendency of sellers to contaminate fruit samples was not negligible (Kudah et al., 2018).

The observations of this study showed that the fruits and vegetables consumable in Oo City were contaminated with microorganisms, fungi and parasites. Contamination that may be due to poor hygiene in the environment where fruits are grown or handled by vendors leads to food and water-borne infections. The impact of these results on public health is immeasurable. The prevalence of diarrhea can increase in people who consume these fruits without proper cleaning. In Nigeria, carrots, cucumbers, tomatoes and peppers are important ingredients in raw or half-cooked lettuce and similar foods. Outbreaks of food poisoning cannot be ruled out in a society where personal hygiene is poor and food distributors are not regularly screened or registered. Isolation of these organisms, at any level, raises serious public health concerns given their pathogenicity. Parasites (Ascaris lumbricoides and E. E. coli found in fruits) can cause gastrointestinal disorders and chronic diarrhea (Oranusi and Braide 2012; Agbalaka et al., 2019). Therefore, consuming these fruits without proper cleaning poses a risk of gastrointestinal illness to the resident. Children who consume improperly washed fruits may be at higher risk. Vegetables are usually not exposed

to sufficient heat to avoid loss of the nutrients they contain, so there is a risk and nutritional risk of gut bacterial infection, especially in places where raw edible vegetables and vegetable contamination are controlled. You need to weigh the benefits of. To further reduce the risk of human illness associated with raw fruits and vegetables, it is necessary to control potential points of contamination. B. Can be achieved during harvest. In process or distribution. Or in the retail market. Proper washing of vegetables with clean water is essential to reduce microbial contamination of vegetables after harvest. Water fortified with various concentrations of organic acids such as citric acid and acetic acid (vinegar) has been shown to reduce the number of microorganisms in fruits and vegetables. After harvesting, vegetables should be put on the market in the proper containers of disinfected vehicles to allow proper air circulation (Oluboyo et al., 2019). Contamination of fresh foods sold in various markets is a serious public health problem worldwide (Li et al., 2020), Mexico (MoralesFigueroa et al., 2021), South India (Ajitha et al). , 2020), Malaysia (Tahar et al., 2021) expressed similar concerns. All customers should get into the habit of washing fruits and vegetables before eating or cooking them or storing them in the kitchen. Therefore, it is important that these fruits pass food hygiene tests from harvest to consumption, but all involved parties are concerned with existing public health laws aimed at reducing the prevalence of food-borne diseases. I will comply with.

Conclusion

Public health parasites such as Ascaris lumbricoides, Entamoeba histolytica, Ancyclostoma duodenale, Taeniaspp. Discovered in this study. Escherichia coli, Klebsiella pneumonia, Staphylococcus aureus, Salmonella typhii, Klebsiella oxytoca, Pseudomonas aeruginosa, Serratia marcescens, Proteus mirabilis, Enterococcus faecalis, Streptococcus faecalis, Streptococcus svulgaris It belongs to the genus Klebsiella. Bacteria and parasites can contaminate fruits and vegetables due to poor agricultural practices and vendor handling. The results of this study clearly show that raw fruits and vegetables sold in Owo's main markets are often contaminated with bacteria, fungi and parasites. These should be seen as potential risks to the community, distributors, carriers, and consumers of these products.

References

Adejayan A, Morenikeji O. Prevalence of Intestinal parasites in vegetables sold in major markets in Ibadan city, south-west Nigeria. Global journal of pure and applied sciences. 2015;21:7-12

Adeleke, M.A., Hassan, A.O., Ayepola, T.T. Famodimu, T.M., Adebimpe, W.O. and Olatunde, G.0. (2012). Public health risks associated with apples and carrots sold in major markets in Osogbo, Southwest Nigeria. Journal of Toxicology and Environmental Health Sciences Vol. 4(8) pp. 140-144, Available online at http://www.academicjournals.org/JTEHS DOI: 10.5897/JTEHS12.019

Agbalaka PI, Ejinaka OR, Yakubu DP, Obeta UM, Jwanse RI, Dawet A. Prevalence of Parasites of Public Health Significance in Vegetables Sold in Jos Metropolis, Plateau State, Nigeria. American Journal of Public Health Research. 2019;7(2):48-57.

Ajiboye, A.E. and Emmanuel T.O. (2021). Assessment of Bacterial Contamination in Ready-to-Eat Fruits and Vegetables Sold at Oja-Oba Market, Ilorin, Nigeria. *Afr. J. Biomed. Res.* 24: 203- 209.

Ajitha S, Vazhavandal G, Uma A, Prabhusaran N. Study on parasitic contamination of common edible fruits and vegetables sold in local markets of Tiruchirappalli, South India. Indian Journal of Microbiology Research. 2020;7(4):362–368.

Akoma ON, Gbarabe CL, Aminu RF. Parasitological assessment of selected edible fruits and vegetables sold at some markets in Lokoja, North Central Region of Nigeria in the Context of Disease Surveillance. Microbiology & Infectious Diseases. 2017;1(2):1-6.

Al Mamun, M., Rahman, S.M., Turin, T.C. (2013) Microbiological quality of selected street food items vended by school-based street food vendors in Dhaka, Bangladesh. *International Journal of Food Microbiology***166(3):** 413-418.

Alli JA, Abolade GO, Kolade AF, Salako AO, Mgbakor CJ, Ogundele MT, Oyewo AJ, Agboola MO (2011). Prevalence of intestinal parasites on fruits available in Ibadan Markets, Oyo State. *Acta Parasitological Globalis***2**(1):6-10

Argudín, M., Mendoza, M.C., Rodiciom, M.R. (2010) Food poisoning and Staphylococcus aureus enterotoxins. *Toxins.* **2(7)**: 1751-1773.

Auta T, Bawa JA, Suchet CM. Parasitic Contamination of Common Fresh Fruits and Vegetables Sold in Markets within Dutsin-Ma Town, Katsina State, Nigeria. Journal of Advances in Biology & Biotechnology. 2017;14(2):1-8. Nigerian Journal of Parasitology. 39(1):10.

Baron EJ, Finegold SM (1990). Bailey & Scott's diagnostic microbiology, VIII edn. St. Louis: Mosby Co. pp. 323-861.

Benti G, Gemechu F. Parasitic contamination on vegetables irrigated with Awash river in selected farms, eastern Showa, Ethiopia. J Parasitol Vector Biol. 2014;6(7):103-9.

Chaichanawongsaroj N, Vanichayatanarak K, Pipatkullachat T, Polrojpanya M, Somkiatcharoen S (2004). Isolation of Gram-negative bacteria from cockroaches trapped from urban environment. Southeast Asian*Journal Tropical Medical Public Health* 35:681-684

Cowan ST, Steel JL (1975). In: Manual for the identification of medical Bacteria, 2nd Ed. Cambridge University Press 1975. pp. 45-114.

Elobeid, T., Aziz, H.A., Mousa, R., and Alzahiri, A. (2014) Survey on the Microbial Quality of Traditional Foods Sold by Street Vendors in Qatar. *Australian Journal of Nutritional Metabolism.***1(2)**: 4-20.

Elom MO, Eze UA, Nworie A, Akpotomi IO. Prevalence of geohelminths on edible fruits and vegetables cultivated in rural villages of Ebonyi State, South-east Nigeria. American Journal of Food and Nutrition. 2012;2(3):58–64.

Evans EGV, RichrdsonMD(1989). Medical mycology: a practical approach. Oxford: Oxford University Press 1989, pp154.

Gboeloh, L.B. &Sounyo, I.I. (2021). Parasitic Contamination of Fresh Fruits and Vegetables Sold in Port Harcourt Metropolis Markets, Rivers State, Nigeria. *International Journal Of Tropical Disease & Health* 42(12): 19-29

Guven, K., Mutlu, M.B., Gulbandilar, A., and Cakir, P. (2010) Occurrence and characterization of Staphylococcus aureus isolated from meat and dairy products consumed in Turkey. *Journal of Food Safety* .**30(1)**: 196-212.

Hassan A, Farouk H, Abdul-Ghani R. Parasitological contamination of freshly eaten vegetables collected from local markets in Alexandria, Egypt: a preliminary study. Food Contr. 2012; 26 (2):500-503.

Jere, S.A., Obajemu, O. and Keziah Y. (2018).Detection Of Fungi Associated With The Spoilage Of*PsidiumGuajava*,*MalusDomestica*And Persia *Americana* From Selected Markets Within Kaduna Metropolis. *Bayero Journal Of Pure And Applied Sciences 11(1): 427 – 430*http://dx.doi.org/10.4314/bajopas.v11i1.67S

Kemajou, T.S., Awemu, G.A., Digban, K.A., Oshoman, C.E., Ekundayo, O.I.&Ajugwo,A.O. (2017). Microbiological Studies of Vegetable Leaves Sold in Elele Market, Rivers-State, Nigeria. Journal of Transmitted Diseases and Immunity (1)1-4DOI: 10.21767/2573-0320.10004

Kudah C, Sovoe S and Baiden F. Parasitic contamination of commonly consumed vegetables in two markets in Ghana. Ghana Med J. 2018 Jun;52(2):88-93.

Li J, Wang Z, Karim MR, Zhang L. Detection of human intestinal protozoan parasites in vegetables and fruits: A review. Parasites Vectors. 2020;13(380):2-19

Mailafia, S., Okoh, G.R., Olabode, H.O.K. &Osanupin, R. (2017). Isolation and identification of fungi associated with spoilt fruits vended in Gwagwalada market, Abuja, Nigeria. *Vet World*. 2017 Apr; 10(4): 393–397.

Malann YD, Tim UI. The Prevalence of Intestinal Parasites on Fruits Sold in Markets Around Gwagwalada Area Council, F.C.T, Abuja. American Association of Science and Technology. 2016;3(2):107-111.

Mohamed MA, Siddig EE, Elaagip AH, Edris AM, Nasr AA. Parasitic contamination of fresh vegetables sold at central markets in Khartoum state, Sudan. Ann ClinMicrobiolAntimicrob. 2016; 15:17.

Morales-Figueroa GG, Sánchez-Guerrero MA, Castro-García M, Esparza-Romero J, López-Mata MA, Quihui-Cota L. Occurrence of intestinal parasites in fruits and vegetables from markets of Northwest Mexico. Journal of Food Quality and Hazards Control. 2021;8:57-65.

Muzaffar, A.T, Huq, I., and B.A. Mallik, (2019): Entrepreneurs of the streets: an analytical work on the street food vendors of Dhaka city,International*Journal of Business and Management*.**4**(2): 80–88.

Nguendo, Y.H.B. (2018) Eating to Live or Eating to Damage One's Health: Microbiological Risks Associated with Street-Vended Foods in a Subtropical Urban Setting (Yaoundé-Cameroon). *Nutritional Food Science International Journal*.**6**(4): 55-57

Obebe, O.O., &, Aluko, O.O., Falohun, O.O., Akinlabi, K.B., ThankGod, O.E. (2020). Parasitic contamination and public health risk of commonly consumed vegetables in Ibadan-Nigeria. 36 :126, 10.11604/pamj.2020.36.126.19364.

Oluboyo, O.B., Olojede, O.G., Akinseye, F.J., Akele, Y.R., Oluboyo, A.O. &Adewumi, F.A. (2019). Bacterial Contamination Of Some Vegetables Sold In Major Markets In Ado-Ekiti, Nigeria. *Int. J. Adv. Res. 7(8), 638-645. ISSN: 2320-5407*. DOI:10.21474/IJAR01/9545

Oluyege, O. A. &Famurewa, O. (2015): Microbial Contamination and Antibiotic Resistance in Enteric Pathogens Isolated from Cooked Foods Sold in Eateries in Ado-Ekiti, Nigeria. British Microbiology Research Journal, 6(4): 236-246.

Oranusi US, Braide W (2012). A study of microbial safety of ready-t-eat foods vended on highways, Onitsha-Owerri, Southeast Nigeria. Int. Res. J. Microbiol. 3(2):66-71

Scallan, E., Hoekstra, R. M., Angulo, F. J., Tauxe, R. V., Widdowson, M.A., Roy, S. L., (2011). Foodborne illness acquired in the United States and major pathogens. *Emergency in Infectious Diseases*, **17**:7–15.

Tahar AS, Bilung LM, Goh CSK, Nillian E, Lim A, Richard RL, Hashim HF, Apun K. Contamination of Intestinal Parasites in Vegetables from Kuching. International Journal of Current Research and Review. 2021;13(4): 31-31.

Tambekar, D.H., Jaiswal, V.J., Dhanorkar, D.V., Gulhane, P.B., and Dudhane, M.N.(2008) Identification of microbiological hazards and safety of readyto-eat food vended streets of Amravati City. *Indian Journal Applied Bioscience*. **7**: 195-201.

Tavakoli, H.R. and Riazipour, M. (2012) Microbial quality of cooked meat foods in Tehran University's Restaurants. *Pakistan Journal of Medical Sciences*.**24** (4), 595-599

Wang, S., Weller, D., Falardeau, J., Strawn, L. K., Mardones, F. O., Adell, A. D., et al. (2016). Food safety trends: from globalization of whole genome sequencing to application of new tools to prevent foodborne diseases. *Trends in Food Science Technology*, **57**:188–198.

Wang, S., Weller, D., Falardeau, J., Strawn, L. K., Mardones, F. O., Adell, A. D., et al. (2016). Food safety trends: from globalization of whole genome sequencing to application of new tools to prevent foodborne diseases. *Trends in Food Science Technology*, **57**:188–198.

Yan, H., Li, L., Alam, M.J., Shinoda, S., and Miyoshi, S. (2010) Prevalence and antimicrobial resistance of Salmonella in retail foods in northern China. *International Journal of Food Microbiology*.**143(3)**: 230-234.

Zwietering, M. H., Jacxsens, L., Membré, J.M., Nauta, M., and Peterz, M. (2016). Relevance of microbial finished product testing in food safety management. *Food Control* ,**60**: 31–

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How to cite this article:
Hasssan Abdulwasiu Oladele, Obeagu Emmanuel Ifeanyi, Akinleye C and Oluwanisola D.O. (2022). Public health risks associated with fruits and vegetables at Owo markets. Int. J. Curr. Res. Med. Sci. 8(2): 39-51.
DOI: http://dx.doi.org/10.22192/ijcrms.2022.08.02.003