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Parasitic Contamination of Raw Vegetables and Fruits Sold in Some Markets in Abia State, Nigeria

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Abstract

Parasitic contamination of raw vegetables and fruits is one of the distinct causes of intestinal infection in most parts of the globe including Nigeria. This study assessed the parasitic contamination of raw vegetables and fruits sold in some of the markets in Abia State, Nigeria. A total of 360 samples comprising different raw vegetables and fruits (i.e 180 samples of vegetables and 180 fruits) were examined using sedimentation concentration technique to detect cysts of protozoan and ova of helminths. The data were analysed by chi-square test using SPSS software version 21. Parasitic contamination (23.6%) was observed in all of the study samples. *Entamoeba histolytica (30.5%), Giardia lamblia (13%), Entamoeba coli (22.3%) and Balantidium coli (7.1%). Ascaris lumbricoides (17.7%) and Strongyloides stercoralis (9.4%)* eggs and larvae of the helminth were observed on the fruit and vegetable samples. Majority of larva identified were from cabbage samples in all six markets. High loads were also observed in waterleaf and carrot samples. Eggplant samples had the least load and contaminated samples were observed only in Ahiaohuru market. Highest load of larva was observed in Mango fruit samples examined. High loads were also observed in Guava and Apple samples. Lowest load of larva was observed in lemon. The fruits and vegetables' high prevalence of intestinal parasites in Abia States reveals that the high infestation of parasitic infection among dwellers are as a result of frequent consumption of contaminated fruits and vegetables sold in the various markets. Farmers, vendors and consumers need to observe adequate hygiene practices such as proper washing, using potable water for irrigation, non-use of animal faeces as manures and non-display of the produce on the bare ground to ensure low incidence of parasitic infections in Abia State.

Keywords: Vegetables, Fruits, Mortality, Nigeria

Introduction

As consumers, there's need to honor that food safety is important in the ingestion of fresh fruits and vegetables. Despite the health benefits deduced from consuming fruits and vegetables, the threat of microbiological impurities in fruits and vegetables are of public concern due to the possibility of fruits and vegetable impurities along the food chain, beginning from the vegetable ranch to the regale table; this concern is worsened by the fact that utmost times, fruits and vegetables are frequently eaten raw or not properly cooked to retain the natural taste and to save heat- labile nutrients as washing may not assure decontamination giving rise to any residing microbes to freely access the alimentary conduit (Yafetto *et al*., 2019) [22]. Still, the consumption of raw and/ or not duly washed fruits and vegetables play a major epidemiological part in the parasitic food-borne conditions transmission as they act as vehicles for the transmission of parasitic infections when defiled throughout the process from planting to consumption (Adenusi, Abimbola, & Adewoga, 2015) [1]. Worldwide, enteric infections causing high morbidity and mortality rates have been associated with infections in communities where poor environmental sanitation and hygiene are current as much as 70% of diarrheal conditions in developing countries are believed to be of food borne origin. Also, the ubiquitary nature of microorganisms (they include resident flora that's nonpathogenic, which contribute to the greater

percentage with pathogenic species that are not many) has made fruits and vegetables to be easily defiled with microbiological, chemical, and physical hazards, because they're frequently grown in open terrain. Ingestion of unfit fruits and vegetables, unwholesome food, drinking of not potable water spoiled, raw, or undercooked fruits and vegetables is one of the means by which the transmission of intestinal parasitic infections is propagated. Fruits and vegetables act as vehicles for the transmission of parasitic infections when defiled as a result of numerous associated factors related to planting, harvesting, transportation, storehouse, market, and at home (especially while preparing it for consumption) (Tamirat, Abdissa, Zeleke, & Teferi, 2014) [19]. Moreover, man's activities cannot be differentiated from microorganisms completely. Numerous disease-causing organisms have made their way into fresh fruits and vegetables which are a great source of a healthy diet for humans (e.g fresh fruits and vegetables demands have greatly increased and this necessitated production of it in larger scales). In the quest of mass production of fruits and vegetables within the shortest period to meet the increase demand, they are contaminated via the process of production which in turns become hazardous to the consumers' health (Gadafi, Denis, Vera & Priscilla, 2020) [10].

Although, studies have shown recently that fruits and vegetables are carriers of protozoan cysts and oocysts (Istifanus and Panda, 2018) [12]. The even distribution of intestinal parasitic infections globally have pose great threats to man's health, economy, and physical and cognitive development particularly among children in developing countries (Bekele, Tefera, Biresaw, & Yohannes, 2017) [6] like Nigeria. Former studies have shown that *Ascaris lumbricoides, Strongyloides stercoralis, Cryptosporidium spp., Entamoebahistolytica, Enterobius vermicularis, Giardia intestinalis, hookworm, Hymenolepis spp., Taenia spp., Trichuristrichiura, and Toxocara spp.,* can infect humans who consume defiled, raw, or erroneously washed vegetables and fruits (Auta, Bawa, & Suchet, 2017) [4]. Consumption of raw fruits and vegetables have been linked with the numerous Protozoan infection's outbreaks in man (Auta *et al*., 2017) [4]. These infections can beget serious medical and public health enterprises, analogous as worm infestation, malnutrition and growth retardation in children, which can lead to annual increase in morbidity and mortality rates. Researchers have shown that the number of reported cases of food borne ails due to consumption of raw fruits and vegetables has been adding and continues to be a common and serious trouble to the health of the public in endemic areas (Eraky, Rashed, Nasr, El- Hamshary, & El- Ghannam, 2014) [8]. Furthermore, the use of feces from man and animals as a manure and wastewater that are not treated for irrigation during planting are the main contributing factors of fruits and vegetables contamination in the pre-harvest stage (Getaneh *et al*, 2020) [11], this leads to increase in intestinal parasitic infections. Likewise, chances of contamination are increased during post-harvest stages like storage, transportation, and marketing conditions as well as unhygienic practices during preparation processing for consumption in food service or home settings (Alhabbal, 2015) [2].

Methods

Study area

The area of study here is the three senatorial zones of Abia State, Nigeria with geographical coordinates of 5,4309 and 7.5247", she has Umuahía as her capital city and Aba her major Commercial city. She occupies 5,834 square kilometers, bounded on the North and Northeast by Anambra, Enugu and Ebonyí State. To the west by Imo State to the East and South East are Cross River State and Akwa Ibom State and to the South is Rivers State. The ethnicity of Abia is Igbo and of South East geopolitical zone of Nigeria.The people whose major occupation are trading, artisans, agriculture, civil and public service.

Study design

The study employed a cross-sectional descriptive survey that involved direct observation, laboratory study and analysis of fruits and vegetables sold in the markets of Abia State.

Sample collection and analysis

A total of 180 fruits and 180 vegetable samples (5 different types of fruits and vegetables from each market) were collected in sterile bags from 6 open markets (2 markets from each senatorial zone). The markets are; Eke-Amiyi and Eke Elu (Abia North), Ubani Central market and Orie Ntigha (Abia Central), Ahiaohuru and Ariaria (Abia North). The fruit samples were Guava (*Psidium guajava*), Orange (*Citrus sinensis*), Lemon (*Citrus limon*), Apple (*Malus domestica*) and Mango (*Mangifera indica*) while the vegetable samples were Waterleaf (*Talinium triangulare*), Fluted pumpkin (*Telfairia occidentalis*), Carrot (*Daucus carota*), Cabbage (*Brassica oleracea*) and Eggplant (*Solanum melongena*). The samples were immediately taken to the microbiology laboratory for analysis as each of the sample was placed in a different plastic bag and labelled with a distinct number and its collection date. Each of the raw vegetable or fruit was soaked in a physiological salt solution for 15 minutes then a vortex mixer was used to vigorously shaken it for 15 minutes. 15 millilitres of the sediment was transferred into a centrifuge tube using a sieve to remove unwanted particles after an overnight sedimentation. The tube was centrifuged at a 3000 revolution per minutes for 5 minutes inorder to concentrate the parasitic stages such as the larva, ova, cysts and oocysts. The supernatant was decanted carefully without shaking after the centrifugation. The parasitic stage was redistributed by gently agitating the sediments by hand and finally examining the sediments under a light microscope uswing × 10 and × 40 objectives. The ova of helminths and coccidian protozoan oocysts were detected using an acid-fast stain. Statistical Package for the Social Sciences (SPSS version 21) was used in analyzing the data and results presented in frequency tables.

Result

Observed egg, larva and lyst Occurrence in vegetable and fruit samples

Six isolates were identified in fruits and vegetable samples analysed. The cysts of four protozoans were observed upon microscopic observation and they include *Entamoeba histolytica (30.5%), Giardia lamblia (13%), Entamoeba coli*

(22.3%) and Balantidium coli (7.1%). Ascaris lumbricoides (17.7%) and Strongyloides stercoralis (9.4%) eggs and larvae of the helminth were observed on the fruit and vegetable samples. Parasitic contamination (23.6%) was observed in all of the study samples.

Table 1: Observed egg, larva and cyst of intestestinal parasirtes and their percentage occurance

Egg / larva and cyst	Number	Percentage (%) Occurrence in total examined samples n=360	Percentage (%) Occurrence in Positive Samples
Entamoeba histolytica	26	7.2	30.5
Ascaris Lumbricoides	15	4.2	17.7
Giardia lamblia	11	3.1	13
Strongyloides stercoralis	8	2.2	9.4
Entamoeba coli	19	5.3	22.3
Balantidium coli	6	1.6	7.1
Total	85	23.6	100

Total Egg, larva and cyst

The load on fruits and vegetables in the six different markets are displayed in Tables 1.1 and 1.2.

In Table 1.1 the percentage load of eggs and larva in fruit samples from the different markets are displayed. Eggs and cysts were found on 4 out of the thirty fruit samples in Ubani market. 5 samples were positive in Orie-Ntigha representing 16.6% of the total fruit samples. Highest load was observed in Ariaria with 10(33.3%) of the fruit samples contaminated with eggs. Highest load of larva was observed in Mango fruit samples examined. High loads were also observed in Guava and Apple samples. Lowest load of larva was observed in lemon.

Table 1.1: Isolate Load on Fruit Samples

Market	Guava	Orange	Lemon	Apple	Mango	Total No of Positive Samples (n=30)	Percentage (%)
Ubani	1	-	-	2	1	4	13.3
Orie Ntigha	2	1	-	-	2	5	16.6
Ariaria	3	2	1	2	2	10	33.3
Ahiaohuru	2	-	1	2	2	7	23.3
Ekeamiyi	-	-	-	2	1	3	10
Eke-Elu	2	1	-	2	3	8	26.6
Total	10	4	2	10	11	37	123.1

Table 1.2 shows larva and egg load on some vegetable samples in the six markets. As with the fruit samples, majority of the contaminated vegetables were observed in Ariaria market with 11 positive samples indicating 36.6%. Ahiaohuru, in the same zone as Ariaria equally had a high load of larva (30%). Majority of larva identified were from cabbage samples in all six markets. High loads were also observed in waterleaf and carrot samples. Eggplant samples had the least load and contaminated samples were observed only in Ahiaohuru market.

Table 1.2: Isolate Load on Vegetable Samples

Market	Waterleaf	Carrot	Eggplant	Pumpkin	Cabbage	Total No of Positive Samples (n=30)	Percentage (%)
Ubani	2	1	-	1	2	6	20
Orie Ntigha	2	3	-	1	2	8	26.6
Ariaria	3	2	-	3	3	11	36.6
Ahiaohuru	2	2	2	-	3	9	30
Ekeamiyi	-	1	-	2	1	4	13.3
Eke-Elu	2	1	-	-	1	4	13.3
Total	11	10	2	7	12	42	139.8

Distribution of Isolates

Majority of the isolates were found in fruit and vegetable samples in Abia South Senatorial Zone (Ariaria and Ahiaohuru markets). All the isolates were observed in Ariaria market. Abia North Senatorial Zone had the least prevalence of contaminated samples.

Isolates	Distribution of Parasites					
	Abia Central		Abia South		Abia North	
	Ubani	Orie Ntigha	Ariaria	Ahiaohuru	Ekeamiyi	EkeElu
Entamoeba histolytica	+	-	+	+	+	+
Ascaris lumbricoides	+	+	+	+	-	+
Giardia lamblia	+	-	+	-	-	-
Strongyloides stercoralis	+	+	+	+	-	-
Entamoeba coli	+	-	+	+	+	+
Balantidium coli	-	+	+	-	-	-

Key: += Present, - = Absent

Discussion

In this study, six kinds of parasites that included the cysts of four protozoans and two ova of helminths were identified upon microscopic observation and they included; *Entamoeba histolytica, Giardia lamblia, Entamoeba coli and Balantidium coli and Ascaris lumbricoides and Strongyloides stercoralis* eggs and larvae were observed on the fruit and vegetable samples, the study discovery is similar to the findings of Odihi *et al.* (2022) [15], in Kaduna State Nigeria, Vincent *et al.* (2022) [21] in Makurdi, Ezeunala *et al*. (2019) [9] in Abuja, Shola *et al*. (2022) [18] in Kwara Central, Nigeria, Orpin, Mzungu & Usman-Sani, (2020) [16] in Dutsin-ma Metropolis, Katsina State, Nigeria, Bashir *et al*. (2019) in Katagum region Northeast Nigeria, Tamirat *et al*. (2014) [19] in Jimma town Southwest Ethiopia, Daphey *et al* (2023) [7], Jemikalajah *et al*. (2020) [13] in Abraka, Delta State and Rabiu *et al.* (2021) [17] in Kano Metropolis, Nigeria. Among the protozoans, the cysts of *Entamoeba histolytica* (30.5%) were the highest occurring and this finding is higher than the report from Dessie town (24%) but lower than the report from Sudan (42%). *Entamoeba coli* (22.3%) was the second occurring protozoan cysts and this shows that there is a fecal contamination, however, the high occurrance of *Entamoeba histolytica* and *Entamoeba coli* could be attributed to their cysts ability to survive long period under cool and moist conditions and variations in geographical distribution. *Giardia lamblia* (13%) was the third identified protozoa followed by *Balantidium coli* (7.1%). According, the most commonly observed helminth ova is *Ascaris lumbricoides* (17.7%) as the most occurring helminth is higher than the reported *Ascaris lumbricoides* (7.4%) study done by Bashir *et al*., (2020) [5] in the Northeast, Nigeria, the sticky eggshell nature of this helminth and their ability to survive unfavourable environmental conditions could play a significant role in its attachment on fruits and vegetables and the *Strongyloides stercoralis* (9.4%) was the least identified helminth although this result isn't in conformity with the result of a study done by Getaneh, Mezgebu and Megbaru (2020) [11] in Northwest Ethiopia where it was reported as the highest detected helminth with a percentage of (13.5%). This is in disagreement with the study done by Al-Megrin (2010) [3] in Saudi Arabia where he reported that *Entamoeba coli* and *Strongyloides stercoralis* were the highest occurring protozoa and helminth respectively responsible for the contamination of fruits and vegetables. The identification of cysts of protozoans and helminths ova/larvae on the fruit and vegetable samples analysed constitute a major threat to health of the population in Abia State.

However, the parasitic contamination (23.6%) on fruit and vegetable samples recorded in this study is almost the same as the (23%) reported by Bashir *et al*., (2020) [5] on a study done in Katagum Region, Northeast and lower than the (48.7%) recorded by Shola *et al*., (2022) [18] in a study done in Kwara Central, both in Nigeria. Comparing this result with studies done in Egypt (36%), Ethiopia (42.6%), Thailand (35.1%), Philipine (40.3%) and Iran (30.0%) (Tefera, Biruksew, Mekonnen & Eshetu, 2014) [20], the parasitic contamination (23.6%) load is lower and this could be as result of differences in our environmental factors such as weather conditions, manures used for cultivation, no of samples analysed, irrigation water used for cultivation, open defeacation by human beings and animals on farmlands, time/season of sample collection, poor or unhygienic handling of fruits and vegetables by farmers as well as vendors and different methods of laboratory used to analyze samples. Moreover, it was seen that the vegetables have more parasitic contamination load than the fruits and this is similar to the study done in Zamfara State by Nasiru, Auta and Bawa (2015) [14]. Although, the reason why the vegetables are more contaminated than the fruits could be that the edible parts of vegetables which grow closer to the soil play an important role in its contamination and also, vegetables have uneven surface which enables parasites to attach more easily and leaves folding resist the effects of washing as vendors tend not to wash vegetables properly because of its softness before display and they try to retain its freshness inorder to attract consumers' patronage while fruits have smooth surfaces that reduce parasitc attachments and enable proper washing.

Furthermore, cabbage (12%) was found to be the most contaminated vegetable and this finding is higher than the report from Katagum Region, Northeast Nigeria (7.42%) but the similiarity that exists between these studies is that they both acknowledged cabbage as most contaminated vegetable and this could be because cabbage has large and rough surface that favour parasites attachment to its surface and it is a creeping plant. Waterleaf (11%) was identified as the second most contaminated vegetable and this is possible because waterleaf are grown all through the year (i.e dry and rainy season) and during dry seasons, contaminated water could be used for irrigation purposes. It was observed that egg plant (2%) was the least contaminated vegetable and mango (11%) has the highest parasitic contamination and this disagree with finding of Tefera, Biruksew, Mekonnen and Eshetu in Ethiopia which they reported that mango is the least parasitic conraminated fruit because of its smooth surface although, the variation in this studies could be attributed to geographical, hygiene level and ecological factors within these countries. Guava (10%) and apple (10%) were identified as the second most contaminated with lemon (2%) being the least contaminated fruits. Analysed samples collected from Ariaria market (33.3%) showed that the Ariaria is the highest contaminated market and Ekeamiyi market (10%) the least contaminated market. However, the reason why there was difference in the contamination level could be associated with the means of transporeting the produces to the markets, manner of display, water used for washing and wetting the products to retain its freshness, obvious indiscriminate dumping of wastes, market chain in which the products pass several hands and contaminated stagnant water around the environs.

Conclusion

The fruits and vegetables' high prevalence of intestinal parasites in Abia States reveals that the high infestation of parasitic infection among dwellers are as a result of frequent consumption of contaminated fruits and vegetables sold in the various markets. Farmers, vendors and consumers need to observe adequate hygiene practices such as proper washing, using potable water for irrigation, non-use of animal faeces as manures and non-display of the produce on the bare ground to ensure low incidence of parasitic infections in Abia State.

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