Research Journal in Advanced Sciences
ISSN: 2709-281X (Online) ISSN: 2709-2801 (Print)

Advanced Sciences

Assessment of geohelminth contamination of vegetables and fruits sold in Gusau markets Zamfara State Nigeria

Review article

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Article History:
Received: 2020-06-20
Revised: 2020-09-28
Accepted: 2020-09-28
Published: 2021-01-01

Keywords:
contamination, fruits, geohelminths, gusau markets, vegetables

How to cite?
Nasiru, M., Kutawa, A. B., & Abdullahi, K. (2020). Assessment of geohelminth contamination of vegetables and fruits sold in Gusau markets Zamfara State Nigeria. *Research Journal in Advanced Sciences*, 2(1). Retrieved from https://royalliteglobal.com/rjas/article/view/475

Published in Nairobi, Kenya by Royallite Global in the **Research Journal in Advanced Sciences**

Abstract

Purpose: This research work is aimed to assess parasitological contamination of vegetables and fruits sold in Gusau markets, Zamfara State, Nigeria in March, 2013.

Design/Methodology: Fruits and vegetables were purchased from four markets that are randomly selected and evaluated for geohelminth larvae and eggs, using sedimentation and flotation techniques.

Findings: Out of 44 helminth eggs/larvae detected in the whole markets, 70.5% were *Ascaris lumbricoides*, 15.9% *Trichuris trichiura*, 9.1% hookworm and 4.5% *Strongyloides stercoralis*. There were no helminth larvae and eggs that were present in tomatoes and garden eggs in the whole markets. The vegetables and fruits in the markets were to some extent contaminated with either helminth eggs, larvae or both, vegetables were found to be more contaminated than their counterparts (fruits). *Lactuca sativa* had the highest contamination. The differences were statistically significant (P<0.001).

Practical Implications: It's recommended that,thorough washing of all vegetables and fruits be done prior to consumption.

Scan and Read

Public Interest Statement

This research work was aimed to evaluate the amount of parasitic contamination in vegetables and fruits sold in Gusau major markets and to help individuals and the public, with useful information on the contamination of surfaces for vegetables and fruits that are consumed raw. The authors listed in this this research work have unanimously agreed with the novelty of this work and have agreed to publish it in this journal without any conflict of interest. Moreover, this work is original and not under consideration or published in any journal.

Introduction

Geohelminths are considered as parasitic nematodes that are transmitted through the soil, there life cycle does not involve any vector or intermediate hosts, they can infect different animals such as humans, and can be spread through faecal contamination of the food, water and soil. Four species of geohelminths cause widespread of diseases in human: *Trichuris trichiura,* the whipworm, which causes Trichuriasis; *Ascaris lumbricoides,* the large round worm, which causes Ascariasis; *Strongyloides stercoralis,* the thread worm which causes Strongyloidiasis; *Anclostoma duodenale* and *Necator americanus* (which causes Ancylostomiasis and Necatoriasis) respectively (Celia and Welcolm, 2002). The infections of geohelminth are mostly found in subtropical and tropical areas of the developing countries, where adequate sanitation and water are lacking (WHO, 2008). Intense and chronic geohelminth infections can result due to iron-deficiency anaemia, malnutrition and morbidity (Etim *et al*., 2002; Ezeamama *et al.,* 2005). Pollution of the soil with faecal materials is the key in the transmission of infections for geohelminth (Izadi *et al*., 2016). The disease geohelminthiasis can be increased due to poor hygiene habits like indiscriminate disposal of faeces for animal and human. This bad habit allows contact of faeces and its microbial load, including geohelminth eggs, with soil. Soil is an important vehicle for development and transmission of geohelminth eggs (Emeka *et al*., 2006).

Literature Review

The act of taking raw vegetables without appropriate washing helps immensely in transmitting the parasitic diseases (Hanif *et al*., 2006; Mahvi and Kia, 2006; and Nazemi *et al*., 2012). There was an increase in the cases of foodborne sickness linked to fresh vegetables that were reported (Cliver, 1997; Nasiru *et al*., 2000; Said, 2012). Different factors could result to contamination of the crops. They were reported to be contaminated since when the plants were in the orchards, during harvesting, fields, transport, distribution, marketing, processing or at home (NPC, 2006; WHO, 2012; and Zamfara, 2009). The contamination of soil with increased application of improperly composted manures and animal wastes to soil where vegetables are produced also help in parasite contamination to the vegetables (Beuchat, 2002; Gupta *et al*., 2010). Bad practice of hygiene during transport, processing, preparation and production by consumers and handlers also leads to

contaminations of vegetable (Larry, 1998). Changes in food consumption patterns and lifestyle, like an increase in the number of people eating food prepared in canteens, fast food outlets and restaurants as well as that obtained from street food vendors who do not abide by safety measure of the food increases the risk of food exposure to the infections (Beuchat, 2000; Nasiru *et al*., 2000; Nordberg, 2004).

There is a dearth of information on the transmission of geohelminthiasis in Gusau, Zamfara State, and North-west Nigeria where local farmers usually package and take their fruits and vegetables to the city markets in unhygienic condition. It was reported to be a habitual practice among different farmers in the study area around to fill surface of the drainages (culverts), soak away with earth materials, leave it overnight and excavate and use as manure in the vegetable gardens. They also purchase human faeces emptied from pit latrines by environmental workers and use as manure in their gardens (Nasiru *et al*., 2000). This research work was aimed to evaluate the amount of parasitic contamination in vegetables and fruits sold in Gusau major markets and to help individuals and the public, with useful information on the contamination of surfaces for vegetables and fruits that are consumed raw.

Methods

2.1 Area of the Study

The study was conducted on vegetables and fruits that are eaten in Gusau Local Government Area of Zamfara State. Gusau is located between latitude 11°53′N and longitude 06°39′E, North-Western Nigeria. The study area is situated in the Northern Guinea Savannah Zone of Nigeria, and occupies a land mass of 3,364km^2 (1,298.8 sq ml) (NPC, 2006), with a population of about 383,712 people ((Mamman *et al*., 2000; Zamfara, 2009). The annual temperature in the area ranging from 17°C-31°C and has a tropical continental climate with distinct wet and dry seasons with the mean annual rainfall record an average of 99mm. The relative humidity in the area is about 50% and reaching 96% during rains (Umoh *et al*., 2001; ZADP, 2008). Agricultural activity serves as the major occupation of the people in the area. The major plants that cultivated include maize, millet, guinea corn and vegetables. In Gusau, as in many other cities in Nigeria, fruits and vegetables are forms of everyday component of the family menu because they are relatively cheap. Such fruits and vegetables are usually unhygienic and unhealthy in nature right from the source to the consumption (Nasiru *et al*., 2000).

Samples were collected from four different markets in Gusau. These include Central market, Tudun Wada market; Dan Juma market and Old Market that operate on daily bases were randomly selected from (Madawaki, Galadima, Sabon Gari and Tudun Wada Districts) for this research. Central market is situated in Galadima District Area (Northern part of Gusau City) between Latitude 120 06'N and Longitude 6014'E; Tudun Wada market is located in Tudun Wada District Area (Eastern part of Gusau City) between Latitude 120 53'N and Longitude 6039'E. Dan Juma market is located in Sabon Gari district area (western part

of Gusau city) between Latitude 120 05'N and Longitude 6041'E; Old Market is located in Madawaki District Area (north-western part of Gusau City) between Latitude 120 06'N and Longitude 6041'E (Umoh *et al*., 2001). Large numbers of people from Gusau metropolis patronizes the markets, in order to buy their fruits, and Vegetables, and are generally eaten uncooked.

2.2 Sample Collection

Six types of fruits and green vegetables consumed in Gusau city were selected in this study; three leafy vegetables Amaranthus/green *(Amaranthus cruentus)*, lettuce *(Lactuca sativa)*, and Tossa jutes *(Corchorus olitorius);* and three fruits viz: tomatoes *(Lycopersicon esculentum)*, red pepper *(Capsicum sp.)* and garden eggs fruits *(Solanum marcrocarpon)*. The samples were purchased direct from the famers and at the smallest retail size available. The samples collected were taken to Parasitology Lab (Department of Biological Sciences), Usmanu Danfodiyo University, Sokoto in insulated box with ice packs and checked for geohelminths (Damen *et al*., 2007; Nasiru *et al*., 2000).

2.3 Sample Analysis

The vegetables and fruits were studied in the lab using both the flotation and sedimentation techniques as previously describe by Damen *et al*. (2007) with slight modifications of the method. About 250g samples of each kind of vegetables and fruits were first weighed and washed using 0.85% NaCl (physiological saline) in a sterile plastic container in order to remove the parasitic larva or cysts and ova. Post washing, the water was left overnight and sieved to remove the debris and was dispensed into tubes (centrifuge tubes), it was followed by centrifugation at 3000 rpm for 15 minutes. After centrifugation, the supernatant was discarded while the residue was mixed carefully, a drop of the water was placed on a slide with the addition of tincture of iodine. It was then examined for parasites stages under light microscope (×10 and × 40 objective lenses). For the Floatation Method: The obtained sediments were re-immersed in zinc sulphate (floatation fluid) and centrifuged again. The addition of floatation fluid was to fill the brim, a cover slip was used to cover the slide. The sample was examined under light microscope (X10 and X40 objective lenses). The parasites were carefully identified using the descriptions of Eneany and Njom (2003) and Wafa (2010).

2.4 Statistical Analysis

A statistical tool called chi-square (x2) was used to check whether there was any relationship that exists between ova and larvae of geohelminths which cause a contamination of different vegetables and fruits, as well as the type of produce and markets locations.

1. Findings

Out of four markets examined, Central Market found to be contaminated with geohelminth eggs and larvae 21(47.7%); Tudun Wada Market 3(6.8%); Dan Juma Market 13(29.5%), and Old Market 7(15.9%) respectively. This result shows that Central Market had the highest number of eggs and larvae, and Tudun Wada Market had the least contamination. There was a significant difference in the presence/ prevalence of geohelminth contamination among the markets (x^2=38.01; df=3; P<0.01) as presented in Figure 1.

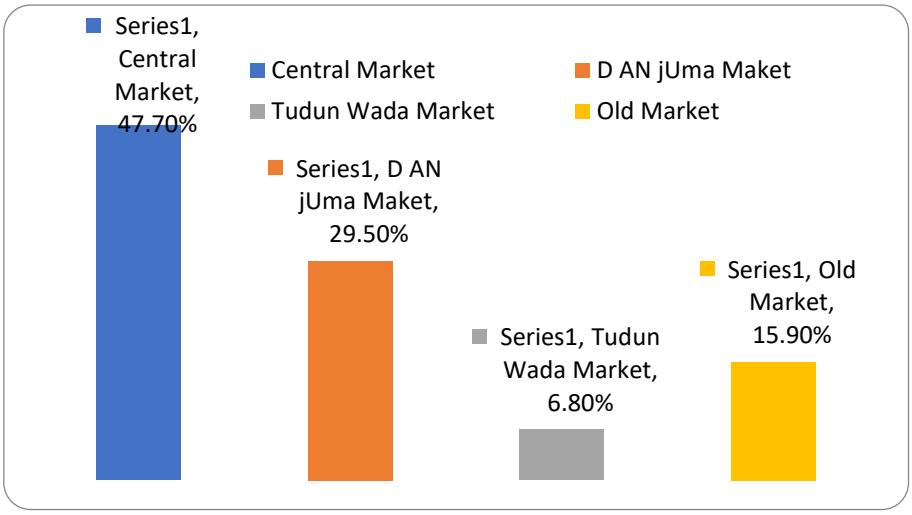

Figure 1: Different levels of contamination of vegetables and fruits from four markets in Gusau.

Figure 2 shows the distribution of parasite eggs and larvae recovered in four markets. The most frequent geohelminth eggs/larvae detected in the whole markets were those of *Ascaris lumbricoides* 31(70.5%), *Trichura trichiuris* 7(15.9%); while the larvae were those of hookworms 4(9.1%) and *Strongyloides stercoralis* 2(4.5%).

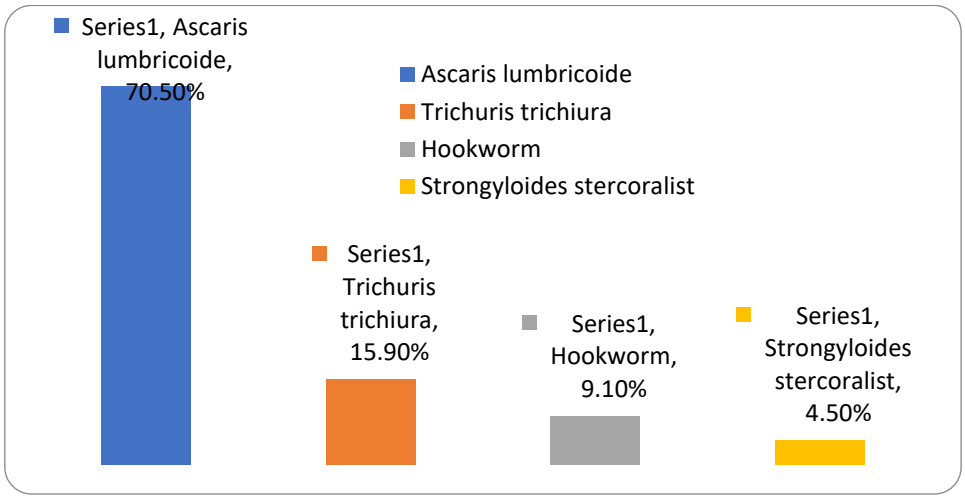

Figure 2: The distribution of parasite eggs and larvae recovered in four markets.

Figure 3 shows that vegetables were more contaminated than fruits. *Lactuca sativa* (lettuce) was the most contaminated with geohelminth eggs/larvae 19(43.2%), followed by

Amaranthus cruentus (green)15(34.1%) respectively. No geohelminth eggs and larvae was detected in *Lycopersicon esculentum* (tomatoes) and *Solanum marcrocarpon* (garden eggs), in all the Markets. A significant difference was obtained in the presence/prevalence of Geohelminth contamination of vegetables and fruits (x^2=95.60; df=5; P<0.01).

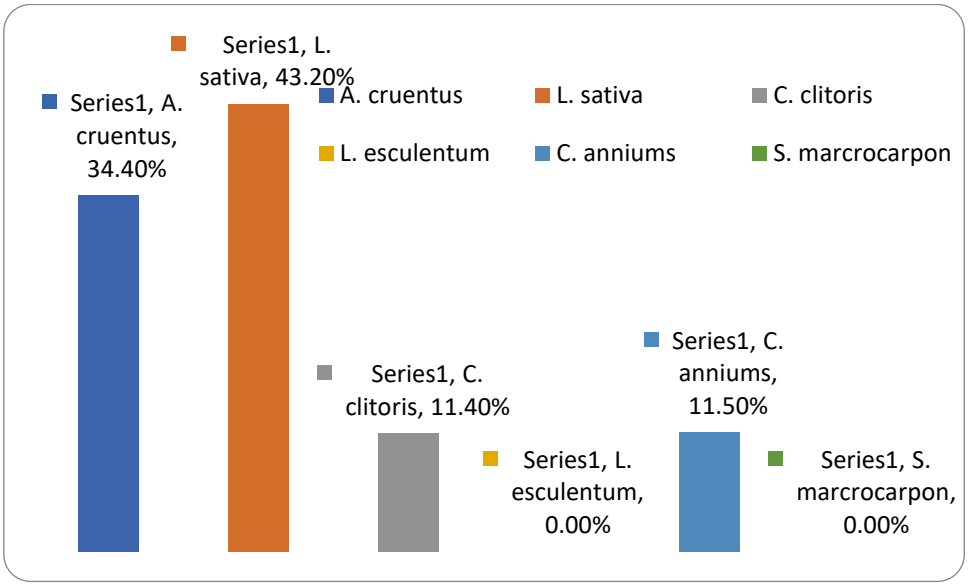

Figure 3: Different contamination levels of fruits and vegetables.

2. Discussion

The result showed the presence of geohelminth eggs/larvae on the vegetables and fruits examined in the research site. Six different kinds of raw vegetables that are consumed commonly in Gusau were investigated these include Amaranthus/green *(Amaranthus cruentus)*, lettuce *(Lactuca sativa)*, and Tossa jutes *(Corchorus olitorius)*; and three fruits viz: tomatoes *(Lycopersicon esculentum)*, red pepper *(Capsicum sp.)* and garden eggs fruits *(Solanum marcrocarpon)*. These vegetables and fruits were consumed commonly as raw and are vital constituents of different salads.

In the present work, *Lactuca sativa* (lettuce) was the most contaminated with geohelminth eggs/larvae 19(43.2%), this contamination could be due to their tough skin due to the leaf folds and this may retain some dirt which may not remove easily using slight washing by the street hawkers (venders) and other sellers. The consumption of these poorly washed vegetables could be the major way for the transmission of contamination by parasite (Damen *et al*., 2007). followed by *Amaranthus cruentus* (green) with 15(34.1%), this could be due to the fact that the vegetables have some flat surfaces which allow parasitic eggs to get attached to their surfaces more easily, either from the farm or when been washed using water that is contaminated (Nasiru *et al*., 2000; Wafa, 2010) bad sanitary condition and ignorance are also attributed to high contamination (Larry, 1998). No geohelminth eggs and larvae were detected in *Lycopersicum esculentum* (tomatoes) and *Solanum marcrocarpon* (garden eggs) in all the Markets. This refers to Vegetables like

tomatoes and garden eggs that has leathery and smoothly surfaces which minimize the attachment of the parasite, this is because their smooth skin makes it easy for the eggs to be carried or washed off even using the slight washing which is done prior to selling (Bawa *et al*., 2014; Nasiru *et al*., 2000; Wapa, 2010; and WHO, 2012), or because the fruits are higher above the soil level than the vegetables. These results were in agreement with that of Eneany and Njom (2003) who reported contamination to be 40% samples of lettuce plant. Different factors could bring about such differences. They include type and number of samples examined, geographical location, type of water used for irrigation, post-harvesting handling methods of such vegetables which are not the same from one country to another and methods used for detection of the intestinal parasites.

Contamination refers in many markets shows that Central Market had the highest rate 21(47.7%), followed by Dan Juma Market with 13(29.5%), then Old Market with 7(15.9%) and least was Tudun Wada Market with 3(6.8%) respectively. The differences in contamination of vegetables and fruits in the four markets may be due to inadequate personal hygiene and poor sanitation. In central markets, People patronize the market because the products are cheaper to buy and always fresh compared to other markets. Despite the fact that it is a modern market and largest deport for varieties of products which are highly demanded in the state, the sanitary condition is very poor at the site where the fruits and vegetables are displayed for sale. However, Business transactions are conducted in an open space, where these products can be seen displayed on ground and refuse dumps nearby. Therefore, the flies could mechanically transfer these parasites ova and cyst from dirt's to products that were displayed. Wind also is known to carry geohelminth eggs from various areas far away from contaminated place (WHO, 2012).

Dan Juma Market had the second contamination with 13(29.5%), the vicinity of the market is not hygienic enough and sanitation activities in the market was very poor, the fruits and vegetables are displayed on ground at the road side near gutters that are contaminated and filled with sand and waste. This may lead to parasitic disease transmission due to poor environmental condition and poor personal hygiene (Nasiru *et al*., 2000; Ashtiani *et al*., 2011). Tudun Wada Market had the least contamination this could be attributed to the washing of vegetables and fruits before displaying them on the tables for sales.

In Gusau areas, some of the fruits and vegetables are sometime consumed raw and unwashed in the farmstead by the farmers, casual consumers, and raw salad at home. Lettuce is usually eaten raw as salad, while tomatoes and red pepper are made into raw salad dishes, this could lead to ingestion of eggs of geohelminth (Damen *et al*., 2007), reported that some fruits and vegetables that are eaten raw may cause diseases. Vegetables and fruits are the main source of helminthes and microbial pathogens (Erdugrul and Sener, 2005; WHO, 2012).

A significant difference was obtained in the presence/prevalence of geohelminths contamination in vegetables and fruits (x^2=95.60; df=5; P<0.01) in the study area. It may be as a result of the degree of contamination which usually differs based on shape and surface of the vegetables and poor hygiene attitudes of the people, right from the planting to harvesting period, which is often associated with the use of human excretes and animal dung as manure, as well as use of urban wastes water for irrigation. Its common practice by the farmers in the study area around Gusau to filled surface of the drainages (culverts), soak away with earth materials, leave it overnight and excavate and use as manure in the vegetables gardens. They also purchase human excretes emptied from pit latrines from environmental workers and use as manure (Nasiru *et al*., 2000). Consumption of vegetables and fruits that are raw is the main reason for transmitting the parasites of food borne sickness, due to the fact that the consumers prepare to retain natural taste and preserve the nutrients derived from fresh vegetables and fruits (Nasiru *et al*., 2000). High presence of geohelminths on vegetables and fruits are because, these markets are characterized by huge presence of refuse dumping sites nearby places, improper disposal of faeces from the local farmers/traders, poor hygienic practice and poor drainage (Nasiru *et al*., 2000).

The most frequent geohelminth eggs/larvae detected in the four markets were those of *Ascaris lumbricoides* 31(70.5%), *Trichura trichiuris* 7(15.9%); while the larvae were those of hookworms 4(9.1%) and *Strongyloides stercoralis* 2(4.5%). This represents a significant public health implication in the study area and it's an indication of faecal pollution. The occurrence of high degree of geohelminth eggs recorded in this study, agree with other several findings. Nasiru *et al*. (2000) reported that *Ascaris lumbricoides* (54.2%) is the most prevalent helminth encountered, followed by hookworms and *Trichura trichiuris.* The presence of *Ascaris lumbricoiudes* on fruits could cause referred childhood growth and childhood malnutrition. Moreover, Nasiru, *et al.* (2015) had documented that among the geohelminths, *A. lumbricoides* is the most frequently encountered. High presence of *A. lumbricoides* could be due to high level of unhygienic practices among the people of the communities. The result also consistent with the reports of Eneanya and Njom (2003) but disagrees with that of Said (2012).

The second most prevalent helminth eggs detected in this study were *Trichuris trichuiura.* It is a geohelminth which has received renewed attention during the past decade because of the increasing recognition that it has important effect on growth. Stunted growth has been demonstrated in trichuriasis even in moderate infection (Wafa, 2010). Hookworm is responsible for loss of blood which leads to iron deficiency anaemia that has profound increment in children and adults. *S. stercoralis* which can cause a chronic infection in humans more often in a host that was detected only on *Amaranthus* and lettuce. Although the percentage prevalence of *S. Stercoralis* in this study is low, yet it deserves greater attention (Nasiru *et al*., 2000).

Different researches in Nigeria have reported the presence/prevalence of geohelminths to be very high. The presence of these parasites is increased by many epidemiological factors like poor personal hygiene, other socio-cultural practices such as the use of urban waste water in irrigation and poor sanitation. These factors are vital in transmitting of helminth parasite from one host to another, and from the soil the soil to a host. Often transmission of geohelminths is by faecal-oral route through eating contaminated food or water (Amoah *et al*., 2007; Daryani *et al*., 2008; and Wafa, 2010). Despite the fact that there is variability in the isolated parasites, Ova of Hookworm and Ova of *Ascaris lumbricoides* were common to all vegetables and fruits in all the research works. This may be due to the fact that these parasites could resist a wide variety of adverse environmental conditions which could serve as an indication of water pollution as a result of indiscriminate defecation which cause pollution in water and farm as previously reported by Damen *et al*. (2007).

Conclusion

The findings of this research work showed that there is high prevalence of geohelminths on vegetables and fruits from different markets in Gusau. This is because people living in this area are still largely ignorant of the danger posed by geohelminthes. This ignorance might be responsible for the persistently high prevalence of geohelminth eggs and larvae in the area which may lead to a huge risk of acquiring geohelminthic infections by consuming vegetables and fruits that were not properly washed.

Recommendations

There is need for individuals from Gusau metropolis, to be washing fruits and vegetable properly before taking it raw.

Conflicts of Interest: The authors listed in this paper have declared no conflict of interest.

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Authorship and Level of Contribution

All authors in this manuscript have read and agree to the published version of the manuscript. Writing original draft preparation, ***Abdulaziz Bashir Kutawa**; paraphrasing and editing, **Manir Nasiru**; Proofreading, **Kabir Abdullahi**. All the authors in this manuscript have read and agreed to the published version of the manuscript.

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