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Full Length Research Paper

SOIL-TRANSMITTED HELMINTH PARASITES CONTAMINATING EDIBLE RAW VEGETABLES AND FRUITS SOLD AT NKWO-EDO MARKET NNEWI NIGERIA

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ABSTRACT
Edible raw vegetables and fruits which supply man with essential supplements could also become vehicles for soil transmitted helminthes (STHs) parasites. Some edible raw vegetables and fruits displayed for sale were procured from Nkwo-Edo market Nnewi and assessed for contamination by ova and larvae of STHs during the peak rainy season period of June and July, 2017. One hundred grams of each leafy vegetables ('Utazi' *Gongronema latifolium*, Garden egg *Solanum macrocarpon*, Bitter leaf *Vernonia amigdalina*) and fresh fruits (African pear *Dacryodes edulis*, Oil-palm *Elaeis guineensis*, Carrots *Daucus carota* and *G*arden egg *Solanium macrocarpon*) were weighed out and examined for ova or larvae of STHs using the sedimentation method. STHs were identified using the key from Atlas of Parasitology. About 36% of Garden egg, 24% of Bitter leaf, and 12% of 'Utazi' leafy vegetables, as well as 45% ofoil palm, 35% of African pear, 20% of Carrots, and 10% of Garden egg fruits were contaminated with different STHs. Generally, 24% and 27.5% of all vegetables and fruits sampled were respectively contaminated with STHs, comprising eggs of *Ascaris lumbricoides* (59.3%), larvae of *Strongyloides stercoralis* (22.2%), eggs of hookworm species (14.8%), and ova of *Trichuris trichiura* (3.7%). Recovery of these STHs emphasizes the need for proper washing of all edible raw fruits and vegetables procured from the study area before consumption. Periodical inspection for the presence of STHs on edible raw fruits and vegetables sold in the markets is advocated.

Keywords: Vegetables, fruits, Soil-transmitted helminthes, Contamination

INTRODUCTION
Vegetables are portions of herbaceous plant's roots, stems, leaves or fruits (Amaechi *et al*., 2016) which are major components of the healthy diet of humans (Simon-Oke *et al.*, 2014; Sunil *et al.*, 2014) while fruits are fleshy seed-associated structures of plants that are edible in the raw state (Yoila and Utitofon, 2016). Despite their nutritional benefits, vegetables

and fruits serve as vehicles for human disease causing agents (FAO 2010; WHO 2012); and studies showed that many vegetables and fruits sold in the markets were contaminated by soil transmitted helminths, STHs (Uneke and Udegbunam, 2015; Abe *et al*., 2016). Studies on STH infections in Nigeria (Asaolu *et al*., 2002; Sam-Wobo and Mafiana, 2006) had shown *Ascaris lumbricoides* as the most prevalent followed by hookworms, *Trichuris trichiura* and *Strongyloides stercoralis*. STH infections are most prevalent in tropical and subtropical areas with poor environmental sanitation, inadequate sanitary facilities, unsafe potable water and poor hygiene culture (Akhlaghi *et al*., 2013). Eating contaminated, raw, or undercooked vegetables and fruits is one of the means by which transmission of intestinal parasitic infections are propagated (Yoila and Utitofon, 2016). Any unhygienic practices during cultivation, processing, transportation and marketing of plant products could lead to their contamination with STHs which, on consumption, may cause human infection (Oranusi *et al*., 2013). There is increasing number of cases of food-borne illness mainly linked to eating of fresh vegetables (Alhabbal, 2015; Sunil *et al*., 2014; Olyaei and Hajivandi, 2013). Nigeria accounts for the highest population infected with STHs in sub-Saharan Africa (Federal Ministry of Health, 2013; Hotez *et al*., 2012). Considering the important roles of fruits and vegetables in human nutrition, there is need for routine and periodical investigation on the presence of STHs on edible raw fruits and vegetables sold to the populace. The aim of this study was to examine edible raw fruits and vegetables displayed for sale in Nkwo-Edo Market, Nnewi for STHs. The objectives of the study were to identify species as well as determine the distributions of STHs contaminating edible raw vegetables and fruits displayed for sale at Nkwo-Edo Market Nnewi, Nigeria.

MATERIALS AND METHODS

Study area: The study area is Nnewi which lies within Longitudes 5°59′41.64″ & 6°52′41.64″East of Meridian, and Latitudes 5°59′ 41.64″ & 6°03′28.44″North of Equator in the Tropical Rain Forest Zone of Nigeria, and east of the Niger River (Nfor, 2006). It comprises four communities namely, Nnewichi, Otolo, Umudim and Uruagu whose indigenes are mainly traders and farmers and depend much on agriculture and commerce for livelihood. Edible raw vegetables and fruits derived from farms within the communities in Nnewi are usually displayed for sale at the strategically located Nkwo-Edo Market quadrangle, which is the target area of study

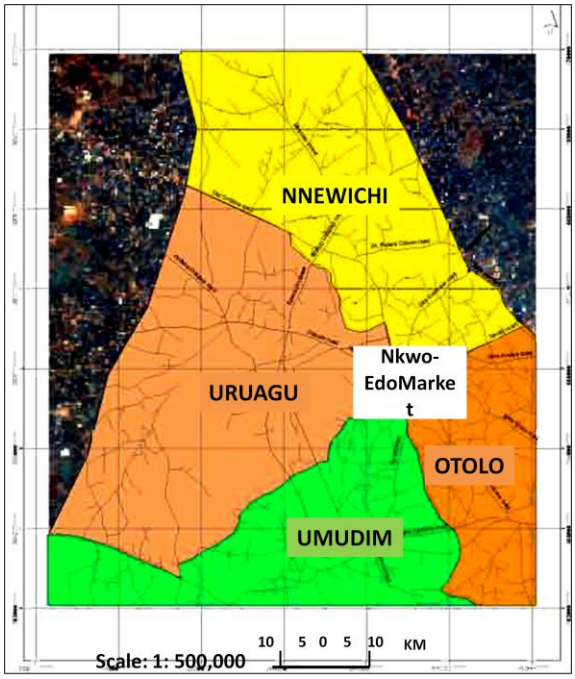

Fig. 1: Map of Nnewi showing Nkwo-Edo (adapted from Orjiako and Igbokwe, 2009)

Sample collection, and identification of STHs: A total of 75 and 80 vegetable and fruit samples composed of Leafy vegetables

of 'Utazi' (*Gongronema latifolium*), 'Garden egg' (*Solanum macrocarpon*), and 'Bitter leaf' (*Vernonia amigdalina*) as well as fruits of African pear (*Dacryodes edulis*), Oil-palm (*Elaeis guineensis*), Carrots (*Daucus carota)*, and Garden egg (*Solanium macrocarpon*) were procured from Nkwo-Edo Market Nnewi during the peak of wet season of June and July, 2017 and further examined for ova and larvae of STH using sedimentation method. Equal weights (100mg) of each sample was taken into properly labeled sterile polythene bags and transported to the laboratory for parasitological analysis within 20 minutes of collection. Each sample was washed for the separation of any ova or larvae of STHs according to Yoila and Utitofon (2016). Concentration of the eggs in the sediment was carried out by centrifugation as described by Amaechi *et al.* (2016). The sediment from each vegetable and fruit was put in different centrifuge tubes and centrifuged at 5000 rpm for 5 minutes. The supernatant was decanted and the sediment was stirred. A drop of each of the sediments was put on the center of clean grease-free glass slide and stained with Lugol's iodine after which a clean cover slip was placed gently to avoid air bubbles and over flooding. The preparation was examined under light microscopy using x10 and x40 objective lens. Various eggs and larvae of STHs present were identified by comparing their morphological features with those in the colored Atlas of Parasitology.

Data Analysis: Data was subjected to statistical analysis using Excel to display histograms showing percentages with error bars at 5% level of significant.

Results

Species of STHs identified are shown in Plates 1 to 4.

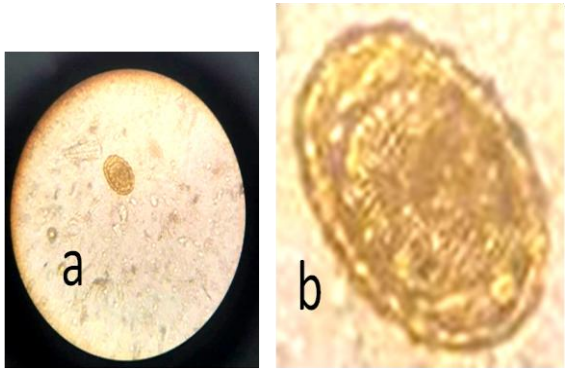

Plate 1: [a] Microscopic slide of *Ascaris lumbricoides* ova. [b] Highlighted *Ascaris* ovum with its characteristic morphological features.

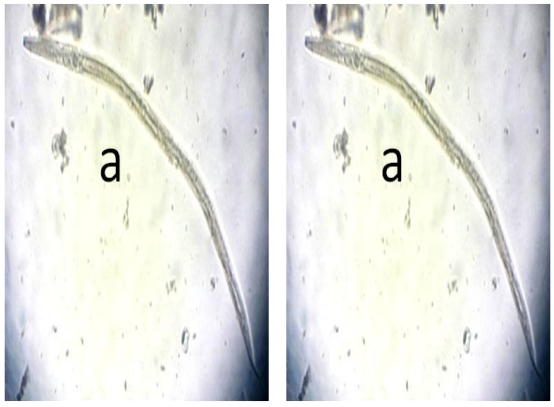

Plate 2: [a] Microscope slide of *Strongyloides stercoralis* larva showing characteristic anterior and posterior features

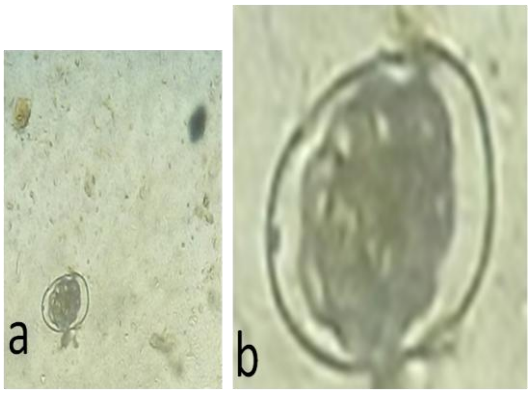

Plate 3: [a] Microscopic slide of eggs of *Hookworm* species [b] Hookworm egg highlighted to show characteristic morphological features

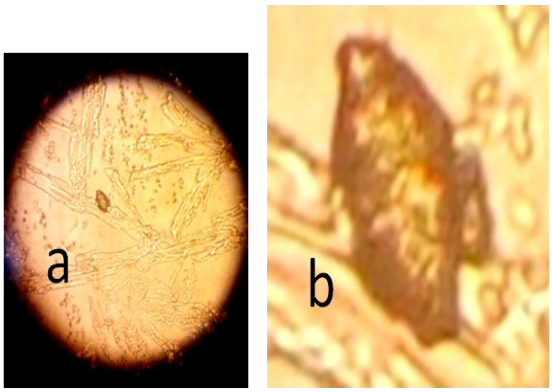

Plate 4: [a] Microscopic slide of *Trichuris trichiura* egg, [b] *Trichuris* egg highlighted to show characteristic operculum.

Similarly, overall percentages of edible raw vegetables and fruits contaminated by STHs, percentages of the vegetables contaminated by STHs, percentages of the fruits contaminated by STHs, distributions of STHs on vegetables, and distributions of STHs on fruits are presented in Figures 1 to 5, respectively.

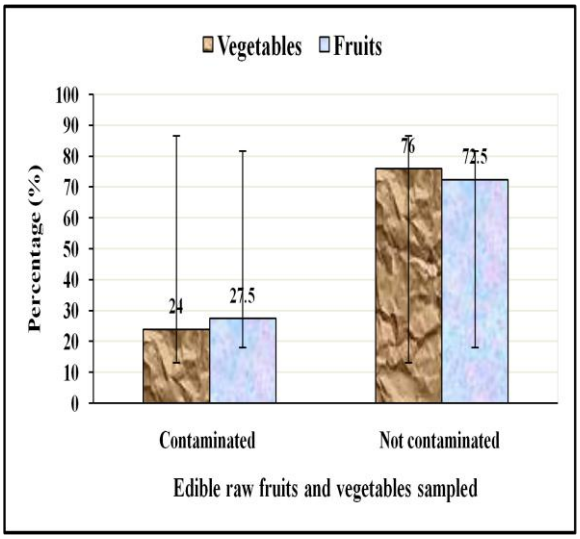

Fig. 1: Overall percentages of edible raw vegetables and fruits were contaminated with STHs (p>0.05)

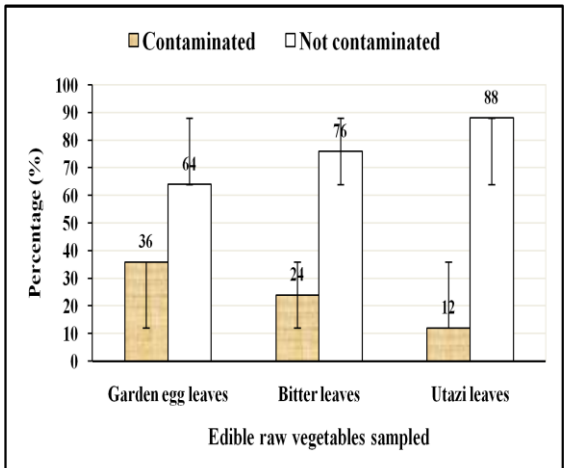

Fig. 2: Percentages of specific edible raw vegetables contaminated by STHs (p<0.05)

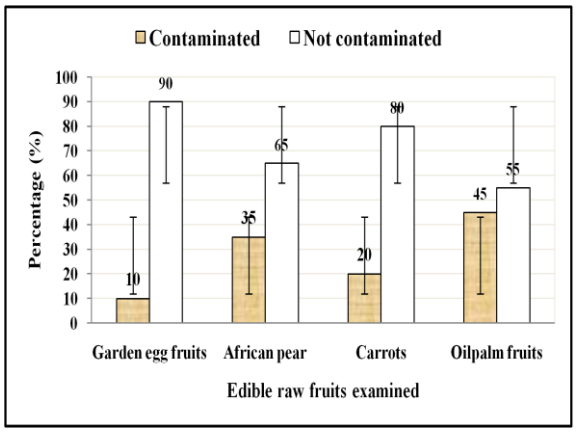

Fig. 3: Percentages of specific edible raw fruits contaminated by STHs (p<0.05)

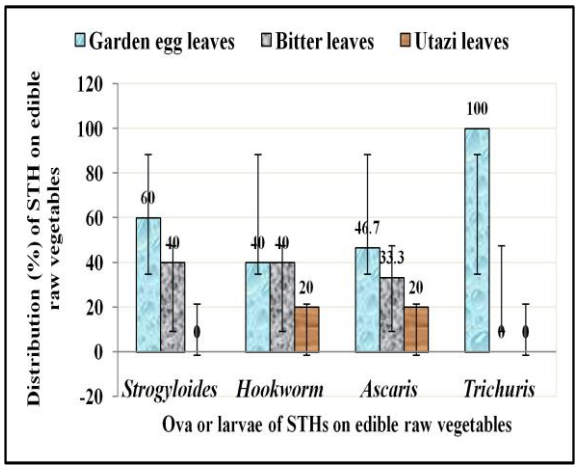

Fig. 4: Percentage distributions of specific STHs on edible raw vegetables (p<0.05)

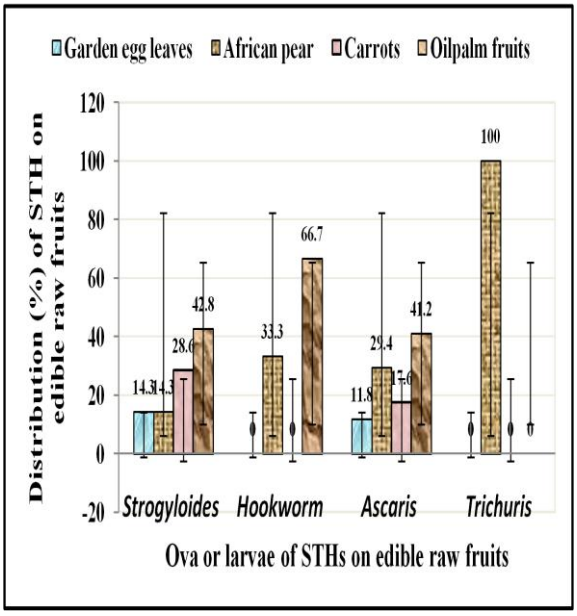

Fig. 5: Percentage distributions of specific STHs on edible raw fruits (p<0.05)

DISCUSSIONS

The STHs observed in the present study (Plates1-4) indicated that the farming environment in Nnewi was experiencing contamination with feacal matter. In the study by Nasiru *et al*.(2015), it was reported that fruits and vegetables irrigated with waste water in Zamfara State were often contaminated with STHs. These STHs have also been widely reported to be most prevalent in Nigeria. Ohaeri *et al.* (2011) reported *A. lumbricoides* with 80.6% as the most prevalent STH on fruits and vegetables in Umuahia Abia State while Yoila and Utitofon (2016), Nasiru *et al.* (2015), and Amaechi *et al.* (2016) reported 22.6%, 65.8%, and 28% for *A. lumbricoides* in Gwagwalada Abuja, Gusau Zamfara State, and Ilorin respectively. Oranusi *et al.*, (2013) also reported *A. lumbricoides* with highest occurrence in selected fruits (37%) and vegetables (39%) sold in Owerri. However, *S. stercoralis* was reported with highest occurrence of 60.4% on fresh vegetables sold in Jos Markets (Ojemudia, 2011) and 28.3% on edible raw vegetables sold in Abakaliki (Ani and Urom, 2015).

The overall parasitic contamination of 25.8% recorded in this study (Fig.1) was less than 57.8% reported for fruits and vegetables from selected Local Markets of Jimma Town, Southwest Ethiopia (Tamirat *et al.*, 2014) and 37.5% from those sold in Lafia Markets in Nasarawa State (Abe *et al.*, 2016) but it was higher than11.87% reported from Kogi, Nigeria (Omowaye and Audu, 2012) and 16.33% from markets in Akure Metropolis, Nigeria (Simon-Oke *et al.*, 2014). These differences could be due to variations in geographical locations, climatic and environmental conditions, as well as types of samples, sample size, sampling techniques, methods of detection of STHs, and socioeconomic status of the local inhabitants.

Although significant differences (p<0.05) in percentage contamination of the fruits and vegetables were evident in the error bars (Figures 2 and 3), the garden egg leaves were most specifically contaminated (Fig. 4) perhaps due to nearness of the leaves to the soil. *S. stercoralis* larvae, especially the infective filariform stages which can spread from the vegetables through direct contact while handling the vegetable has been reported to give rise to an overwhelming fulminating infection in humans (Muniswamappa *et al*., 2012).

It could be noted that contaminated 'Utazi' leaves (Fig. 4) which are commonly plucked and instantly chewed raw for its medicinal benefits could be a source hookworm and *Ascaris* infections. The public health importance of recovering *Trichuris* ova on examined garden egg leaves (Fig. 4) and oil-palm fruits (Fig.5) is that *T. trichiura* can cause grave morbidity in the colon. It was observed that garden egg leaves and oil-palm fruits are easily and

readily consumed raw in the study area. Humans infected with *T. trichiura* through ingestion of infected raw fruits and vegetables may develop bloody colitis and even diphtheritic caecitis with thickening, ulceration and necrotizing lesions on the mucosa which may lead to severe anaemia, dehydration, jaundice and eventual death (Burrows and Lillis, 1964).

CONCLUSION

This study has shown that *A. lumbricoides*, *Hookworm*, *S. stercoralis* and *T. trichiura* infections may be contracted through handling and consumption of contaminated edible raw fruits and vegetables sold in around Nnewi. Prevention of contamination at all points from production to consumption of raw fruits and vegetables can be achieved through reemphasis on the dangers of open defeacation, need for composting of farmyard manure before application, and washings of edible raw fruits and vegetables several times with domestic salt before consumption to avoid STH infections. Result from this study may serve as useful guide for evidence-based policy decision to treat water meant for irrigation purposes in Nigeria.

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