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PREVALENCE OF SOIL-TRANSMITTED HELMINTHS IN SOME SELECTED VEGETABLES SOLD WITHIN DAMATURU METROPOLIS

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Abstract*: Soil-Transmitted Helminthes (STH) commonly known as intestinal worms, have increasingly been recognized as an important public health concern, as over 2.3 billion people in tropical and subtropical regions of the world are exposed to infections by one or more species of these parasites. These helminth eggs/ova are mostly found attached to various vegetables, which humans consume either raw or cooked. The study investigates the prevalence of soil-transmitted helminths (STH) in some selected vegetables, sold in Damaturu Metropolis Markets (Modern Market, Gwange, and Bayan Tasha). Fifteen (15) samples each of washed and unwashed vegetables were collected (cucumber, cabbage, lettuces, green pepper, carrot, and spinach), totaling 180 samples. Preparation and treatment of the samples was performed using sedimentation concentration method to obtain the STH eggs. The results revealed that about 54 unwashed vegetable (60%) had more STH contamination compared to washed vegetable 36 (40%). Unwashed Cabbage has the highest contamination rate with 13(14.4%), followed by unwashed Spinach, Lettuce, and Cucumber each with 09(10%), respectively. Hookworm has the highest occurrence of 15(21.7%) followed by Strongyloides with 13(18.8%), while the least occurrence of 09(13.0%) was observed with Taenia spp. and Trichuris trichiura each. It's recommended that proper washing and disinfection of vegetables should be carried out before consumption as they significantly reduce the number of contaminated STH in the vegetables.*

Keywords: *Hookworm, soil-transmitted helminths, treatments, unwashed vegetables, vegetables.*

INTRODUCTION

Soil-transmitted helminths infections (STHs) are one among the most important common infections in countries in low resources (Legese *et al.,* 2022). Helminth's infections are caused by the following parasites; *Ascaris lumbricoides, Trichuris trichiura, Hookworms or Strongyloides stercoralis* are among the Neglected Tropical Diseases (NTDs) (Nisa *et al.,* 2022). According to world Health Organization (WHO) nearly 1.5 billion people are infected by soil transmitted helminths (STHs), globally, with the highest prevalence reported from sub-Saharan Africa, South Africa, South America and Asia (Lebu *et al.,* 2023). Infections with soil-transmitted helminth (STH) affect more than one billion people particularly the rural poor of the developing world. Approximately one-third of the world's population is infected with at least one species of STH, with *Ascaris lumbricoides,* infecting 800 million people, *Trichuris trichura* 600 million, hookworm, 600 million and resulting in up to 135,000 dead annually

(Ohaeri and Unogu, 2011) STHs have also been classified among the most prevalent neglected tropical disease as they persist exclusively in the poorest population (Nock *et al.,* 2003).
Warm climates and adequate moisture are essential for the hatching or embryonation of STH eggs in the environment in development of larvae. Important contextual determinants for human infection are poverty, lack of sanitation and inadequate hygiene (i.e. absence of hand washing with soap after defecation and before eating and walking bare foot). In such social ecological systems, multiple species of STHs occurs via contamination of contaminated soil (hookworm) or consumption of eggs contaminated food of *A. lumbricoides* and *T. trichura*. (Phiri *et al.,* 2000).

Vegetables are portions of herbaceous plants, 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 structure of plant that are edible in the raw state (Yoila and Utitofon, 2016). Despite their nutritional requirement, fruits serve as vehicles for human disease-causing agents (FAO, 2010, WHO, 2017) and studies have shown that many fruits are sold in markets where soils are contaminated by soil-transmitted helminths (Uneke andUdegbunam , 2015).

Apart from that, vegetables and fruits also have positive impact on the body weight regulation, hypertension and other related conditions such as diabetics, atherosclerosis and strokes. Due to the diverse health benefits of vegetables and fruits to humans, especially those that are eaten raw, can be contaminated more especially with soil-transmitted helminth (STH) parasites if not properly washed (Udegbunam 2015). Several studies have shown that consumption of raw vegetables is one of the major rates by which STH are propagated and this affect more than a quarter of the world population (Mohamed *et al.,* 2016). The extent of contamination of vegetables with STH depends on different unhygienic practices such as the use of untreated waste water contaminated with sewage for irrigation (Tefera *et al.,* 2014). This is because cultivation of vegetables is mostly carried out by peasant farmers who solely depend on irrigation and natural rainfall. Contamination of vegetables can also occur as a result of various associated factors related to planting preparation or during processing, collection, post-harvest handling and storage, transporting to market and other unhygienic conditions.

METHODOLOGY

Sample Collection

Six types of vegetables including cucumber (*Cucumber calypso*), Cabbage (*Brassica oleracea*), lettuce (*Lactuca sativa*), carrot (*Daucus carota*) green pepper (*Capsicum* sp.) and Spinach (*Spinacia oleracea*). The choice of the vegetables used in the study was based on their availability, eaten raw and have high consumption by the local population. Equal numbers of samples (15 each for the washed and the unwashed, totaling 180 samples) were collected from the selected markets (Modern market, Gwange and Bayan tasha). All samples were collected separately, put in plastic bags, properly labelled and brought to the laboratory for parasitological analysis.

Sample Treatment

The sample preparation and examination were performed using sedimentation concentration method for STH eggs as described by Al-Megrm (2010) with some modifications. Two hundred and fifty grams (250 g) each of vegetable samples were placed separately in a plastic container and washed with 10 ml physiological saline solution (0.95% NaCl w/v) for the removal of STH egg or larva. Water used to wash the vegetables was left overnight for sedimentation. After sedimentation, 5 ml of the sediment was transferred to a centrifuge tube and centrifuged at 2000 rpm for 20 minutes. After centrifugation, the supernatant was carefully discarded into the disinfectant jar and the sediment was re-suspended. A drop of the suspension was applied to the Centre of a glass slide and drop of lugols iodine was applied. A clean cover slip was placed gently on slide to avoid air bubbles. The preparation was examined under the microscope using X10 and X40 objectives. The eggs of STH were identified based on morphological details as described by Chiodini *et al.* (2001).

Data Analysis

Data was analyzed using Chi Square in SPSS version 24 to establish significant difference in the prevalence of STH between washed and unwashed vegetables. A P-value of <0.05 was used as a statistically significance difference.

RESULTS

A total of 90 unwashed vegetables samples were collected. Out of the total number of the samples, 54 (60%) were found to be infected with STH parasites and the remaining 36 (40%) were found un-infected. Our findings also revealed that, out of the six vegetables sampled, cabbage harbored the highest STH parasite (13(14.4%)), followed by cucumber, Lettuce, and spinach 9(10%) respectively. The least prevalence was observed in carrot 8(8.8%), and green pepper 6(6.7%) (Table 1 below).

Table 1: Percentage prevalence of Helminthes parasite in unwashed vegetable samples

Vegetables	Total unwashed vegetables	Unwashed vegetable positive	Unwashed vegetables negative	Percentage of unwashed positive	Percentage of unwashed negative
Cucumber	15	09	06	10%	6.7%
Cabbage	15	13	02	14.4%	2.2%
Lettuce	15	09	06	10%	6.7%
Green pepper	15	06	09	6.7%	10%
Carrot	15	08	07	8.8%	7.8%
Spinach	15	09	06	10%	6.7%
Total	**90**	**54**	**36**	**60%**	**40%**

The result also indicated that out of the 90 washed vegetables sampled within Damaturu metropolis, about 18(19.8%) of the vegetables were contaminated with at least one STH

parasite and the remaining samples were found free of the STH parasite 72(80.2%), as shown in Table 2.

A total of 51 vegetables of both washed and unwashed indicated the presence of one or more STH parasites/eggs. This difference was statistically significant as (AP value <0.05).

Table 2: Percentage prevalence of Helminthes parasite in washed vegetable samples

DISCUSSION

The results from the study showed a high prevalence of STH contamination in vegetables sold in selected markets in Damaturu Metropolis. These findings revealed how improperly washed vegetables contains parasites which can pose public health problem to consumers. The research indicated that the overall STH contamination rate was 38.3%. This agrees with the findings from other part of Nigeria as studies by Bashir *et al*. (2020), Agbalaka *et al.* (2019), Ikpeze and Chima (2017) and Patrobas *et al.* (2018), who revealed high contamination of STH on vegetables especially on cabbage and lettuces. Research by Amaechi *et al.* (2016), however, showed non prevalence of STH on various unwashed vegetables. Cabbage 14.4% was found to harbored most of the STH contamination in unwashed vegetables, followed by spinach and cucumber which have a prevalence rate of 10% respectively. The cost of cabbage and spinach in the study area is less when compared with other vegetables and this might cause their poor handling by retail stores as they are always affordable to buyers in the Damaturu communities and available in large quantity.

The discrepancy in the prevalence of STH contamination may be due to differences in the surface area and shape of the vegetables. The high prevalence rate observed in spinach, cabbage, carrot and lettuce may be attributed to the fact that these vegetables have larger and uneven surface area which might probably increase the sticking of these STH eggs either in farm or when washed with contaminated water (Tefera *et al.,* 2014).

In terms of STH observed in this present study, hookworms had the highest prevalent rate of 21.7%. This finding is in agreement with studies conducted in Thailand (Punsawad *et al.,* 2019), Iran (Rostami *et al.,* 2016), Sudan (Mohamed *et al.,* 2016) and Ghana (Duedu *et al.,* 2014) which had prevalence rate of 16.6%, 2.6%, 43.9% and 13%, respectively. The high prevalence of hookworm in the present study could be as a result of use of human excreta as manure in the region. Lack of proper sanitation and use of human waste contaminated water might also be responsible for hookworm infection in the study area. Additionally, the high prevalence of hookworm might be as a result of differences in geographical location, type of soil used and climatic condition (Silver *et al.,* 2018).

The species of STH parasites detected include *Strongyloides, Taenia* spp*., Trichuris trichiura*, *Entamoeba* spp., Hookworm and *Ascaris lumbricoides*. Hookworm 15 (21.7 %) was the most frequently detected contaminant followed by *Strongyloides* which had the prevalence rate of 13 (18.8%). *Taenia* spp. and *Trichuris trichiura* had the least prevalence rate of 09 (13.0%) each. The highest prevalence of Hookworm was detected in cabbage and least frequency from carrot. *Strongyloides* was detected more in spinach and carrot samples but less frequent in cabbage, lettuce and green pepper. Ova of *A. lumbricoides* was detected in lettuce and green pepper with the high frequency but not detected from the samples of carrot. *Strongyloides*

and *Entamoeba* spp., were the second most observed STH in the present study with the prevalence rate of 18.8% and 17.4%, respectively. Our finding was consistent with previous studies carried out by Tefera *et al.* (2014) in Jimma Town, Ethiopia and Agbalaka *et al.* (2019)

Vegetables	Total washed vegetables	Washed vegetable positive	Washed vegetables negative	Percentage of washed positive	Percentage of washed negative
Cucumber	15	02	13	2.2%	14.5%
Cabbage	15	04	11	4.4%	12.3%
Lettuce	15	02	13	2.2%	14.5%
Green pepper	15	03	12	3.3%	13.3%
Carrot	15	04	11	4.4%	12.3%
Spinach	15	03	12	3.3%	13.3%
Total	**90**	**18**	**72**	**19.8%**	**80.2%**

Table 3 indicated hookworm has the highest prevalence with 15(21.7%) followed by Strongyloides 13(18. the least parasite detected were *Teania* spp., and *Trichuris trichiura* with 09(13.0%) respectively.

Table 3: Species of Parasites and their prevalence in washed and unwashed vegetables

Detected Parasites	Frequency in unwashed vegetables	Frequency in washed vegetables	Total Prevalence
Strongyloides	09	04	13(18.8%)
Taenia spp.	06	03	09 (13.0%)
Trichuris trichiura	07	02	09 (13.0%)
Entamoeba spp.	09	03	12 (17.4%)
Hookworm	13	02	15 (21.7%)
A. lumbricoides	07	04	11(15.9%)
Total Prevalence	**51 (44.4%)**	**18 (20.0%)**	**69(38.3%)**

Table 4: Chi-square value of the isolates

Chi Square (χ2)	P-value
2.26	0.458
4.20	0.580
14.21	0.001

in Jos, Nigeria which reported a 21.9% and 58.1% prevalence of *Strongyloides* contamination, respectively. The high prevalence rate of *Strongyloides* observed in this study might be attributed to its complex life cycle which has a free-living stage in the environment that does not require a host for its proliferation (Jourdan *et al.,* 2018, Schär *et al.,* 2013). Most likely, the incongruity in the prevalence of STH contaminations between the present study and others might be attributed to the variation in geographical location, type and number of samples examined, methods used for detection, different laboratory techniques used, type of water used for irrigation, socio-economic activities such as post harvesting handling methods. Besides, the water used to wash vegetables can also play a vital role in the epidemiology of transmission of parasitic diseases. This study found out that there was significant difference ($\chi2=14.21$, $P=0.001$) between the occurrence of STH parasites on washed and unwashed vegetable types. This finding agrees with that of Fallah *et al.* (2016) which reported that traditional washing reduces the rate of contamination drastically but does not totally remove parasites from vegetables. Similarly, the finding is also in conformity to that of Patrobas *et al.* (2018) who reported that there was a significant difference between washed and unwashed vegetables sold in Zaria market, Nigeria.

CONCLUSION

This research indicated high prevalence of STH eggs in vegetables sold in the selected markets of Damaturu metropolis, especially eggs of hookworm which is more prevalent. This is of public health concern as it indicates that humans can be at risk of food-borne infection from these contaminated vegetables, as vegetables are very important diet for humans. Creating awareness of the importance of washing and disinfecting of vegetables before consumption should be carried by the relevant authorities as this will help to reduce their prevalence rate. Proper treatment of urban or rural wastewater used for irrigation of vegetables should also be implemented.

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