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Parasitological examination of Ava stream used in irrigation in Enugu State, South-Eastern Nigeria: An implication for helminth transmission

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The parasitological examination of Ava stream in Abakpa Nike, Enugu state, Nigeria, was investigated to identify the species and load of parasites in the stream. Five different sites were sampled; these sites were chosen based on the different anthropogenic activities going on around these sites. One litre sample each was collected from these sites and were preserved by the addition of 10% formaldehyde (2 ml/L), and were transported to the laboratory. The samples were examined using the flotation technique. The species of parasites identified include *Schistosoma haematobium*, *Ascaris lumbricoides*, *Hymenolepsis nana*, *Enterobius vermicularis*, *Trichuris trichuria*, *Diphybotrium latum*, and *Taenia* species. Samples of Ogburugbu, recorded the highest egg count/L, as well as the highest percentage occurrence, and were followed closely by Ugwuagor, while Agbalike site recorded the least occurrence. This research has helped to identify the possible health risk of consuming raw vegetables and fruits irrigated with wastewater and organic manure sources and the unhygienic activities of the people.

Key words: Parasites, examination, anthropogenic, stream, irrigation.

INTRODUCTION

Wastewater is any water that has been adversely affected in quality by anthropogenic influence (Cornish et al., 1999). It comprises of liquid waste discharged by domestic residences, commercial properties, industry, and/or agriculture and can encompass a wide range of potential contaminants and concentrations. Around 90% of wastewater produced globally remains untreated, causing widespread water pollution, especially in developing countries (Tchobanoglous et al., 2003). Increasingly, agriculture is using untreated raw and wastewater for irrigation since there is no alternative to farmers due to scarcity of water resources (IWMI, 2010).

Raw and wastewater reuse for irrigation, as practiced with Ava stream, is a common practice to overcome water scarcity especially in countries with limited water resources (Mara and Cairncross, 1989). Defecation around water bodies as well as leakage of sewage materials containing human excreta is a common practice around Ava stream due to poor standard of living of those living around this area. However, there is a potential risk of transmission of diseases through excreted organisms in the case of irrigation with untreated wastewater, as well as those natural water receiving human excreta (Feachem, 1983).

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The health hazards associated with direct and indirect wastewater use in irrigation agriculture are of two kinds: the rural health and safety problem for those working on the land or living on or near the land where the water is being used, and the risk that contaminated products from the wastewater use area may subsequently infect humans and animal through consumption or handling of the foodstuff or secondary human contamination by consuming foodstuff from animals that used the area (WHO, 1989). Therefore, in order to prevent the transmission of diseases, it has been recommended that only treated wastewater be used for crop irrigation (IWMI, 2010).

The objectives of this study were to (1) determine the level of parasite contamination of Ava stream and (2) assess the health risk of consuming vegetables and other fruits (uncooked) irrigated with the stream.

MATERIALS AND METHODS

The study area is Abakpa Nike, Eastern part of Enugu State, South-Eastern Nigeria. It covers about 8,422km^2, with an estimated population of about 120,835 people, which fall in the group of low income earners and majority of whom are farmers, traders and students, with few civil servants.

Ava stream forms the major source of water for people living in Abakpa metropolis. It flows East-South of Enugu State capital city. The stream is utilized for both domestic and agricultural purpose. Due to low economic status of the people living in this area, majority of their residential buildings lacks basic sanitary facilities and at such, faecal matters are deposited in and around the stream, as most people choose bush method as alternative method of defecation. Cultivation of vegetables of different kinds such as those used uncooked, in making African salad (spinach, tomato, pepper, lettuce, *Solanum* species, and *Telferia* species), and those eaten after cooking (pumpkin, bitter leaf, curry leaf, okra, etc.) form the major farming activities around the stream since the stream serves as the only source of irrigation water.

Experimental

Water samples from Ava stream, were collected from five (5) different sites: Ogwuagor, Ogburugbu, Agbalike, Silas, and Ifoo, respectively. These sites were chosen based on personal observation of the anthropogenic activities such as washing and bathing, scooping of the water into irrigation farms, promiscuous discharge of human and animal waste direct into the water, use of animal and poultry dropping for organic fertilization of the vegetable within and around the stream. Samples of 1 L were collected from each site and preserved by the addition of 10% formaldehyde (2 ml/L) in sterile bottles and are transported to Applied Biology Laboratory, Faculty of Biological Sciences, Ebonyi State University Abakaliki. In the laboratory, the samples were allowed to settle for 8 h to sediment overnight.

The supernatant was carefully removed and discarded without disturbing the sediment, using a siphon. The sediment was then transferred to centrifuge tubes. The walls of the sedimentation container was washed thoroughly using a spray bottle with detergent solution and the rinsing was added to the sediments in the centrifuge tubes. All the recovered materials were centrifuged at 1000 g for 15 min. The supernatant was removed and discarded and the sediments transferred to one tube. Flotation technique which is ideal for the recovery of helminth eggs was used by suspending the pellet in an equal volume of aceto-acetic buffer (pH 4.5) (Cheesbrough, 1999).

The mixture was re-centrifuged at 1000 g for 15 min and the pellets was transferred to microscope counting cell for final examination using objectives 10 and 40× magnification. The total number of eggs/L(N) present in the original sample of the water was determined from the equation:

$$N = AX/PV$$

Where N is the number of eggs per litre of sample, A is the number of eggs counted in the counting slide or the mean of counts from two or three slides, X is the volume of the final products (ml), P is the volume of the microscopic counting cell (0.3 ml), and V is original wastewater sample volume.

RESULTS

The analysis of this survey shows that Ava stream is contaminated with helminth eggs of different classes of Nematode, Trematode and Cestodes, respectively. Among the Trematodes encountered were the eggs of *Schistosoma haematobium*; Nematodes encountered were *Ascaris lumbricoides*, *Enterobius vermicularis*, and *Trichuris trichuria*. Among the Cestodes implicated were the eggs of *Taenia* spp., *Hymenolepsis nana*, and *Diphyllobotrium latum.* The quantification of these helminth eggs in Ava water samples from the five different sites is shown in Table 1. As shown in Table 1, the Ava stream contained different groups of helminthes, including those mentioned earlier. There was significant difference between the total egg count/L in samples of the five different sites sampled ($P < 0.05$). This difference was the most significant between Ogwuagor and Ogburugbu.

Table 2 shows the percentage of occurrence of different helminth eggs from the five different sites sampled. The effluents of Ogburugbu had the greatest percentage followed by Ogwuagor. Silas and Ifoo shared equal percentage occurrence while Agbalike has the least occurrence.

Of all the parasitic eggs isolated in the Ava stream from the five sites sampled, *A. lumbricoides* was the most frequently recovered (Table 1).The mean total egg count/L in the five different sites was much higher in Ogburugbu (mean= 2.4 egg/L) than the other four sites. This was closely followed by Ogwuagor with the mean total egg count/L of 2.2 eggs/L. However, the difference between the mean total egg count/L in Ogburugbu and that of Ugwuagor was 2.4 eggs/L.

DISSCUSION

Water is a vital need of both plants and animals and this has necessitated to a higher demand to maintain our day to day needs. The Enugu State Government has developed water production and sanitation scheme whose sole responsibility is to service water to the entire people of Enugu and environs. This notwithstanding has led to scampering of water by villagers who do not have access

Table 1. Quantification of parasite eggs in Ava water samples from five different sites of sample collection.

Parasite	Sites of collection and number of parasites identified				
	Ogwuagor (n=11)	Ogburugbu (n=12)	Agbalike (n=5)	Silas (n=6)	Ifoo (n=6)
Schistosoma haematobium	1	4	1	0	0
Ascaris lumbricoides	3	3	1	4	1
Hymenolepsis nana	3	2	0	1	1
Enterobius vermicularis	2	0	2	0	2
Trichuris trichuria	0	0	1	0	0
Diphylobotrium latum	0	2	0	0	1
Taenia spp.	2	1	0	1	1

Table 2. Percentage occurrence of helminth eggs from the five different sites sampled.

Site	Volume of sample examined (V, L)	No. present (%)
Ogwuagor	1	11 (1.1)
Ogburugbu	1	12 (1.2)
Agbalike	1	5 (0.5)
Silas	1	6 (0.6)
Ifoo	1	6 (0.6)

to either good portable water sources to service their domestic needs. Ava people lives at the Eastern part of Enugu State. This has affected their easy access to portable water, may be because of their bed rock. Ava water is one of the most accessible water sources among their inhabitants as this is seen to assist their fast need of water. As pertaining to food and water, this stream has served a dual purpose of agricultural irrigation and drinking sources not only, but washing, bathing and even serving their domestic animals. This has transposed to the emergence of other uncalled act of defecating within and around the stream, dumping refuse and other ill transmitting activities which has yielded propagation of parasitosis among their users and domestic animals. This was evident in earlier work of El kettani et al. (2008) which showed prevalence of intestinal helminthiasis in a group exposed to raw wastewater to be 4.7%. The use of domestic animal dung as organic fertilizers are not left out in their agricultural practices, but this is seen to do more harm than good, because these waste animal dungs serve as a vehicle of parasite transmission especially their infective stages as well as other human pathogens. Of these, helminth infections pose the greatest risks and are a serious public health concern (WHO, 1989). However, the result of this study showed that Ava stream contained different helminth eggs. These parasite species identified were classified into three groups: Cestodes, Trematodes, and Nematodes. The commonest among the identified species however, was *A. lumbricoides* with mean concentration of 2.4 eggs/L. This result agrees with other studies which showed the frequent presence and high concentration of *Ascaris* eggs in wastewater and raw sewage worldwide as reported by Stott (1997), Valbuena (2002) and Coelho et al. (2001).

In addition, the resistance of *Ascaris* to external conditions (Crompton, 1989), allows the eggs to remain viable longer than other helminth eggs (Arfaa, 1987; Erdogrul and Sener, 2005).

The stream used in irrigation in this study does not respond to the WHO standard of <1 helminth egg/L (WHO, 1989), since this study implicated 1 egg/L of water. Consequently, it is not recommended for irrigation of vegetables especially those which are eaten raw. This finding is in accordance with the earlier work of Hajjami et al. (2013) which recorded mean concentration of 8.98 eggs/L. There was a great variation in parasite eggs identified in the five different sites sampled, with Ogburugbu, recording the highest number of parasite eggs/L. This was probably due to the rate of human activities going on around these sites as earlier discussed in this work. The consumption of raw vegetables and fruits irrigated with this stream also plays an important role in the transmission of parasitic contaminations (Arther et al., 1981; Daryani et al., 2008). More reason could be attributed to the fact that population around this area were economically poor, they have a very low standard of living and as such, they lack basic sanitary facilities and therefore, all faecal and other human waste are discharged directly into the stream. The occurrence of the egg of *S. haematobium* indicates the presence of infected individual who possibly could have passed their infected urine into the stream few hours before the time of sample collection.

An earlier survey conducted by Emenyonu et al. (2010) on the effect of waste water use on vegetable crop production in Imo State, Nigeria, shows that wastewater use has negative effect on vegetable crop production some of which they mentioned to include bad odour as well as parasitic infection of the irrigated crops and vegetables. Similarly, studies in different countries by World Health Organization (WHO, 1989), have served to highlight the impact of these practices on the environment and health, especially when these wastewaters, are used in irrigation agriculture.

CONCLUSION/RECOMMENDATION

Ava stream is highly loaded with eggs of helminth parasites and this could mean a serious danger to people, animals and the environment in general. Poor sanitary hygiene as observed within Ava stream illustrates the sanitary and environmental risks associated with the use of this stream as shown by the result of this study. These risks would even be higher if crops and vegetables irrigated with this stream are consumed raw. Both people working around Ava stream and the consumers of the vegetables and other agricultural products produced and irrigated with the stream have the greatest risk of helminthic infections.

However, it is recommended that government should issue warning to owners of residential houses around this stream, forcing them to build good toilets or have their houses sealed by her sanitation agency, this will discourage defecation around the stream. Also, inhabitants of these areas should be educated on the dangers of urinating inside the stream as well as direct discharge of sanitary waste into the stream. A survey should be carried out to identify those individuals passing blood in urine. Lastly, agricultural produce around this stream should be washed with clean water and properly cooked before consumption.

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