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Research Article

Assessment of Parasitic Contamination of Lactuca Sativa (Lettuce) Sold in Three Different Markets in Yenegoa

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Abstract: Lettuce, a green leaf salad vegetable, is cultivated extensively and holds significant economic value due to its high consumption rate. However, the potential for parasitic contamination of lettuce, despite its nutritional and health benefits, raises public health issues. The study was aimed at identifying the parasites present in lettuce and to identify whether market locations are associated with the distribution of the parasite. The study was conducted in 3 markets (Tombia, Swali, and Opolo markets) in Yenagoa, the capital city of Bayelsa State, Nigeria. A total of 30 lettuce samples were obtained with 10 samples from each market. 50grams of each sample were prepared, centrifuged and sediments were examined microscopically for parasite presence while parasitic load was also determined. The results showed that in Opolo market, *Strongyloides species* recorded the highest frequency (4), while *Giardia species* and *Trichuris* were detected just once respectively. Swali market had four different parasites detected; *Ascaris sp* (2), *Giardia sp* (3), *Entamoeba sp* (1), *Strongyloides sp* (5), *Trichuris sp* (2). In Tombia market, four different parasites were identified; *Balantidum sp* (3), *Ascaris sp* (1), *Entamoeba sp* (4), and *Strongyloides sp* (2). There was no significant (p-value>0.05) association between markets and occurrence of parasites. There was a significant difference in the parasitic load among lettuce in the three markets. The study has demonstrated that parasites are present in lettuces sold in the markets, however the changes in their occurrence was not due to market situations, although parasitic load may difference among the three markets.

Keywords: lettuce, markets, parasites, vegetable

Introduction

The heightened public consciousness about the benefits of a healthy diet has led to a surge in the demand and inclusion of fresh vegetables in meals, largely due to their accessibility, freshness, flavor, and health advantages [1]. Both the Food and Agriculture Organization and the World Health Organization advocate for a daily vegetable intake of more than 400 g/day to maintain good health [2,3]. In Nigeria, Lettuce (Lactuca sativa) is a popular vegetable choice, consumed in a variety of ways including raw, cooked, and as an ingredient in numerous dishes, sauces, salads, and beverages [4].

Lettuce, a green leaf salad vegetable, is cultivated extensively and holds significant economic value due to its high consumption rate worldwide [5]. As a leafy vegetable

crop, it is a rich source of vitamins and minerals. It is commonly used in salads along with tomatoes, carrots, cucumbers, or other salad vegetables, and is often served by itself or with a dressing. The diverse applications of lettuce underscore its importance in many people's diets [5,6].

However, the potential for parasitic contamination of lettuce, despite its nutritional and health benefits, raises public health issues. This risk is exacerbated by the fact that lettuce is frequently consumed fresh or lightly cooked, and washing may not ensure complete decontamination. Therefore, any parasites present could easily enter the digestive tract. Intestinal parasites are a significant public health issue, particularly in tropical and subtropical regions of the world [7-11]. The incidence of food-borne diseases linked to the consumption of raw vegetables has been rising in recent years. The consumption of raw vegetables plays a crucial role in the epidemiology and transmission of parasitic food-borne diseases [12]. Vegetables have been found to harbor various parasites, including protozoan and helminth species. Protozoans such as *Cryptosporidium sp*, *Giardia intestinalis*, *Cyclosopora cayetanensis*, and *Toxoplasma gondii* are commonly found in vegetables. In addition, roundworms such as *Trichinella species* and *Anisakis species*; Tapeworms such as *Diphyllobothrium species* and *Taenia species* have been implicated [12,13].

Epidemiological research has also shown that regions of the world where parasitic diseases are prevalent in the population are often linked to areas where wastewater is frequently used to irrigate vegetables and where the consumption of raw vegetables is common [14]. Consuming vegetables irrigated with wastewater without proper washing could lead to parasitic infection [15]. Furthermore, many outbreaks caused by parasitic contamination often go undetected or are underestimated in developing countries, which are associated with inadequate or non-existent systems for routine diagnosis and monitoring [14,15].

In Bayelsa, the production and consumption of lettuce are relatively high, as observed in the behavior of local vegetable consumers [16,17]. Bayelsa is situated in the Southern part of Nigeria, geographically located within latitude 4 o15’ North and latitude 5o23’ South. The average monthly temperature ranges from 25oC to 31 o C [18]. The state's primary soil types are young, shallow, poorly drained soils and acid Sulphate soils, although variations exist [16,17]. These factors favor vegetable production. The desire to prepare balanced meals has led to a significant demand for lettuce in the state [16,17]. This increase in demand is accompanied by public health concerns surrounding lettuce consumption. Therefore, this study aims to examine the parasitic contamination of lettuce vegetables in Bayelsa.

Materials and Methods

Research Location

The research was carried out in three distinct markets in the Yenagoa metropolis (4º58’6.132” N, 6 º 5’ 58.92” E); these markets are Tombia market, Swali market, and Opolo market. Bayelsa is situated in the southern region of Nigeria. Geographically, the state lies within latitude 4 º15’ North and latitude 5 º23’ South. It is bordered by Delta state to the North, Rivers to the east, and the Atlantic Ocean to the west and south. The

amount of rainfall in Bayelsa state varies from one location to another. The average monthly temperature ranges from 25ºC to 31ºC. The State's primary soil types are young, shallow, poorly drained soils and acid Sulphate soils, with some variations. These conditions make it suitable for vegetable farming in the state.

Figure 1. Bayelsa state map [18]

Sample Collection

A total of 30 samples were gathered from the three markets. Each market (Opolo market, Swali market, and Tombia market) contributed 10 samples. The samples were then transported to the microbiological laboratory at the Federal University Otuoke for analysis of parasites.

Analysis of Parasites in Samples

Each sample, weighing fifty grams, was measured using an electronic weighing scale. It was then washed in a plastic bowl filled with 0.85% normal saline. The water was subsequently filtered to eliminate small particles. The filtrate was centrifuged at 3500rpm for 10 minutes. After centrifugation, the supernatant was discarded, and the sediment was examined under a light microscope using low-power (10X) and high-power (40X) objectives for stages of parasites (cysts, eggs, or larvae) after adding a drop of Lugol's iodine solution [19,20]. Parasitological identification keys will be used to identify the detected parasites.

Statistical Analysis

The collected data were statistically analyzed using SPSS version 21.0. The proportion was calculated, and a Chi-square test was performed. The significance level was set at α=0.05.

Results

Table 1 presents the results, which show varying degrees of parasitic contamination in the selected markets. Opolo recorded the highest number of infested samples (7), while Swali market recorded the least number of infested samples (4). Tombia market recorded 5 contaminated samples. However, there was no correlation between the infection rate and the market sites.

Table 1. Association between Parasitic infection rate and market locations

Markets	No of examine samples	No of infested (%)	χ^2	P
Opolo	10	7(70)		
Swali	10	4(40)		
Tombia	10	5(50)		
Total	30	16(53.3)	1.875	0.392

Table 2 presents the analysis of variance of the parasite load of the sample locations. The results indicate significant statistical difference between Opolo market and Tombia market ($p<0.05$). The highest parasite load was recorded by Opolo market while the least parasite load was recorded by Tombia market.

Table 2. Parasite load

Markets	Mean ± STD	p-Value
Opolo	12.0 ± 2.10	<0.05
Swali	7.0 ± 1.03	
Tombia	9.0 ± 1.00	

Different types of parasites were detected in the lettuce sampled from various markets. Table 3 below presents the results for the types of parasites detected in the various markets and their frequency of occurrence. In Opolo market, *Strongyloides* sp recorded the highest frequency (4), while Giardia sp and Trichuris were detected just once respectively in the study area. Swali market was observed to have more parasitic contamination. Four different parasites were detected; *Ascaris sp* (2), *Giardia sp* (3), *Entamoeba sp* (1), *Strongyloides sp* (5), *Trichuris sp* (2). In Tombia market, four different parasites were identified; *Balantidum sp* (3), *Ascaris sp* (1), *Entamoeba sp* (4), and *Strongyloides sp* (2).

Table 3. Types of parasites detected in Opolo

Opolo	Frequency	Swali	Frequency	Tombia	Frequency
Giardia sp	1	*Ascaris sp*	2	*Balantidium sp*	3
Strongyloides sp	4	*Giardia sp*	3	*Ascaris sp*	1
Trichuris sp	1	*Entamoeba sp*	1	*Entamoeba sp*	4
		Strongyloides sp	5	*Strongyloides sp*	2
		Trichuris sp	2		

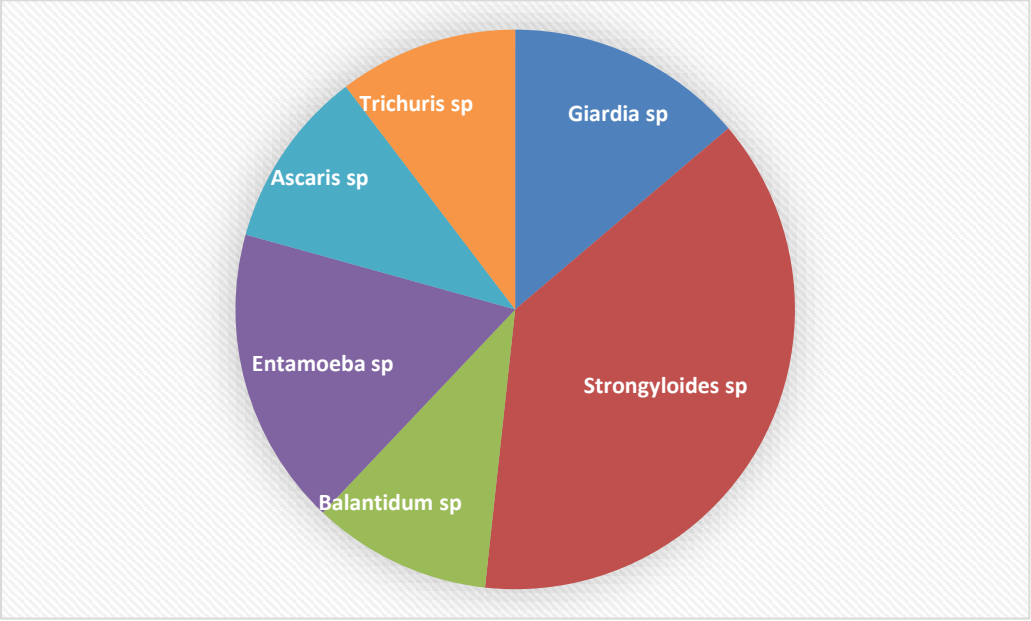

Figure 2. Percentage of occurrence of parasites

Figure 2 presents the results for the percentage of occurrence of all the parasites detected in the three markets. The results show that the *Strongyloides* sp had the highest percentage of 38. Other parasites such as *Giardia* sp had 14%, *Trichuris* sp (10%), *Ascaris* sp (10%), *Entamoeba* sp (17%), and *Balantidium* sp (11%).

Discussion

The findings from the samples collected from the study area revealed a varying degree of parasitic contamination. Opolo recorded the highest number of infested samples (7), while Swali market had the least number of infested samples (4). Tombia market had 5 contaminated samples. The variation in the number of contaminated samples could be attributed to several factors. [21] Proposed that parasites can contaminate lettuce in

numerous ways; they might be present on the hands of field workers, marketers, buyers, or individuals working in processing plants, or in the water used to pre-wash the product, during transport or packaging. They might also be present in the soil where the vegetables are grown, in animal manure used for fertilizer, or in the water used for irrigating vegetables. These contaminating factors may vary across the three different markets. The storage, handling, and processing of the vegetable may also differ. This is corroborated by the work of [22]. They reported that in Africa, there are numerous open markets where vegetables and fruits are sold. In these markets, fresh produce is exposed to the surrounding environment, including domestic animals, which represent an additional factor for food contamination.

In Opolo market, Strongyloides sp was recorded with the highest frequency, while Giardia sp and Trichuris were detected only once respectively in the study area. Swali market was observed to have more parasitic contamination. Four different parasites were detected; *Ascaris sp, Giardia sp, Entamoeba sp, Strongyloides sp, Trichuris sp.* In Tombia market, four different parasites were identified; *Balantidum sp*, *Ascaris sp*, *Entamoeba sp*, and *Strongyloides sp*. The difference in the parasitic composition of the samples could be due to the source of contamination. This study also reported a significant variation in the parasitic load in the various markets studied. Opolo market recorded the highest parasite load while Tombia market recorded the least parasite load. The differences in the parasite load between the different markets sampled may have arisen due to differences in handling, processing, and storage of the samples. [23] suggested that the use of untreated irrigation water and unconventional organic manure for production increases the likelihood of parasitic contamination of vegetables as these agricultural inputs are sometimes sources of parasites. [24] reported that most farmers use untreated irrigation water, untreated animal, and human feces as manure, which are known to contain various species of parasites that are of medical and veterinary importance.

In recent studies of parasite prevalence in fresh vegetables, the most reported species were Cryptosporidium spp., Giardia duodenalis, Cyclospora cayetanensis, Entamoeba spp, Toxoplasma gondii, Balantidium coli, Blastocystis sp., Cystoisospora belli, Enterocytozon bieneusi, Ascaris lumbricoides, Trichuris trichiura, Strongyloides stercoralis, and hookworms [25,26]. This is similar to the findings of [27]. In their study, they evaluated the prevalence of parasitic contamination of vegetables in Katsina Metropolis and recorded an overall prevalence of 42.7%. The highest prevalence was recorded in Ascaris lumbricoides nematode representing 25% and 58% of total and infected samples respectively. The least prevalence rate was recorded in Ova of Hymenolepsis nana with 1.11% and 2.60% respectively. Similarly, [13] determined the prevalence and predictors of parasitic contamination of fruits and vegetables collected from local markets in Jimma Town, Ethiopia.

The overall prevalence of parasitic contamination was 57.8%. Strongyloides like parasite (21.9%) was the most frequent parasitic contaminant followed by *Toxocara spp* (14.7%), *Cryptosporidium spp* (12.8%), *H. nana* (3.8%), *Lamblia spp* (7.5%),

Lumbricoides spp (6.7%), *E. histolytica* (5.3%), *Cyclospora spp* (5.0%), and *H. diminuta* (1.4%).

The results of this study showed that the *Strongyloides sp* had the highest percentage of 38. Other parasites such as *Giardia sp* had 14%, *Trichuris sp* (10%), *Ascaris sp* (10%), *Entamoeba sp* (17%), and *Balantidium sp* (11%). The presence of these parasites may be important route of transmission of intestinal parasites and shown to be an important source of food-borne outbreaks in developing countries [29,30]. For example, [22] reported that *Ascaris lumbricoides*, a parasitic round worm causes Ascariasis; a debilitating human disease. [31] reported that *Strongyloides spp* can cause both respiratory and gastrointestinal symptom.

Conclusion

This study revealed that parasites were present in lettuce sold in Opolo, Swali and Tombia markets. However, the locations of these markets were not identified as being associated with the prevalence or occurrence of the parasites. On the other hand, the study demonstrated notable difference in their parasitic load among the three markets with Opolo having the highest parasitic load and Swali having the least parasitic load.

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