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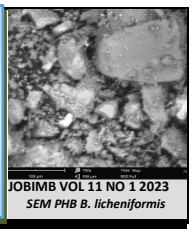

Prevalence of Helminth Parasites in Commercially Marketed Fruits and Vegetables in Selected Markets in Lokoja Metropolis, Kogi State, Nigeria

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ABSTRACT

Fruits and vegetables are commonly consumed foods that are rich sources of essential vitamins, fibres, antioxidants, and bioactive compounds. Most of these vegetables and fruits are eaten raw without much processing and can serve as vehicles for the transmission of parasites and microorganisms. This study aimed to determine the prevalence of helminths in commercially marketed fruits and vegetables in Lokoja metropolis, Kogi State, Nigeria. One-hundred and eight (108) fruits and vegetables were sampled from three (3) different markets within Lokoja and examined for parasite contamination using wet mount and microscopy. A total of 27 (25%) fruits and vegetables were positive for parasite contamination while 81 (75%) were negative. Of the 27 parasite-contaminated fruits and vegetables, cabbage (29.63%) was the most contaminated, followed by lettuce (22.22%), mango (18.52%), guava (14.81%), cucumber (11.11%), and apple (3.70%). Twelve (44.44%) of the contaminated fruits and vegetables were purchased from Natako market, 10 (37.04%) were purchased from Kpata market, and 5 (18.52) were purchased from Lokongoma market. Although the frequency of fruits and vegetables contaminated with parasites was significantly lower than the number without parasite contamination ($p<0.05$), there was no significant difference in the prevalence of parasites contaminating different vegetables and fruits ($p>0.05$). A total of 4 helminths were isolated as contaminants of fruits and vegetables in Lokoja metropolis. Of these, *Strongyloides stercoralis* (40.74%) was the most prevalent, followed by *Ascaris lumbricoides* (25.93%), *Trichuris trichiura* (18.52%), and Hookworm (14.81%). Hence, fruits and vegetables should be properly washed with clean water before consumption.

INTRODUCTION

A fruit is the mature ovary of a plant or the succulent edible part of woody plants, while vegetables are the edible portions of a plant that can be eaten as food [1,2]. Fruits and vegetables are very important parts of the human diet as they are energy-dense foods rich in vitamins, fibres, antioxidants, minerals, and other bioactive compounds [3-6]. Daily or consistent consumption of fruits and vegetables have been globally associated with reduced risks to cardiovascular diseases, stroke, hypertension, coronary heart disease, glaucoma, dementia, cancer, and type 2 diabetes mellitus [7,8]. Antioxidants contained within these fruits and vegetables neutralize free radicals, which have deleterious effects against host cells and tissues [9]. Fruits and vegetables have historically held a place in dietary guidance due to their richness in vitamins, minerals, fibres, and phytonutrients that are of significant health benefits. Hence, the immense health benefits attributable to fruits and vegetables informed the decision of the world health organization (WHO) and the food and agriculture organization (FAO) to recommend a daily intake of 400 g of

vegetables and fruits [10,11]. However, these fruits and vegetables harbour microorganisms and parasites that can be potentially pathogenic to humans, hence predisposing humans to the risk of foodborne diseases [12-14]. Different research studies have associated the increasing prevalence of foodborne parasitic infections with the consumption of unwashed and raw fruits and vegetables [15-17]. Also, the use of polluted and untreated water supply for the irrigation of farmlands during planting as well as post-planting handling of fruits and vegetables also increase the risk of parasitic contamination with helminthic eggs and protozoan cysts [8,18-19].

Almost any ready-to-eat fruit or vegetable that has been contaminated with pathogens, including geohelminths could potentially cause diseases. However, several factors hinder the epidemiological traceability for fruits and vegetables as carriers of foodborne parasites in developing countries. These factors include economic instability, lack of political will, poor healthcare delivery system, non-functional environmental/food protection agencies, and paucity of scientific information on the parasitic profile of ready-to-eat food substances, particularly fruits and vegetables [20].

Unlike foodborne microbial diseases, foodborne parasitic diseases rarely get the required attention despite its potential public health significance in resource poor regions [21]. This is due to several reasons, including lack of awareness of the risk they pose to public health, the comparatively long period between infection and manifestation of symptoms, and wide disparity in foodborne parasites in clinical presentations, pathologies associated with infection, evolutionary diversity, and diagnostic characteristics [22,23]. Hence, this study was carried out to determine the prevalence of helminthic parasites on commercially-marketed fruits and vegetables in markets within Lokoja metropolis, Kogi State, Nigeria.

MATERIALS AND METHOD

Study area

The study was conducted within the metropolis of Lokoja, Kogi State, Nigeria. Lokoja lies at the confluence of rivers Niger and Benue. As the capital of Kogi State, Lokoja is located between latitude 7°45'N and 7°51'N and longitude 6°41'E and 6°45'E. It is 170 km Southwest of Abuja, has a total land area of 3,180 km^2, and a total population of about 692,050. It has an average temperature of 32.4°C, with the highest temperature being between March and April, and the lowest being between December and January. The predominant languages in Lokoja includes Igala, Ebira and Nupe, Bassa Nge. For this study, three (3) different markets (Kpata, Lokongoma and Notaco markets) within Lokoja metropolis were selected.

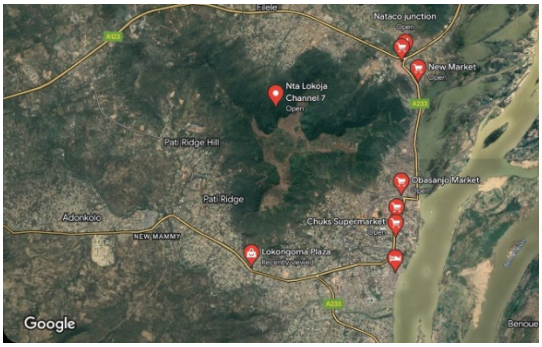

Fig 1. Satellite map showing market areas from where fruits were collected.

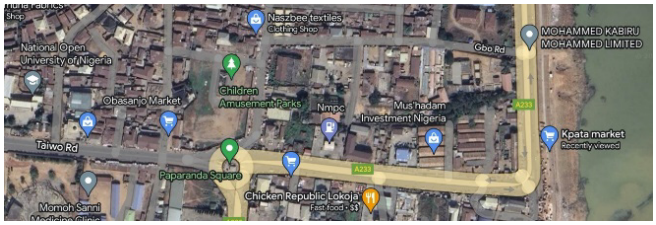

Fig 2. Satellite map showing Kpata market.

Sample collection

One hundred and eight (108) samples of cabbage (*Brassica deracea*), cucumber (*Cucumis sativus*), lettuce (*Lactus sativa*), mango (*Magnifera indica*), guava (*Psidium guajava*), and apple (*Malus domestica*) were purchased from different vendors within the selected markets. Samples were collected into properly labelled sterile plastic bags and transported to the laboratory for analysis.

Parasitic examination of samples

About 200 g of each sample were placed in separate containers and washed with 100 mL physiological saline solution for the removal of ova, cysts, and larva. The solution used for washing the vegetables and fruits were allowed to stand for five (5) hours after which the upper layer was discarded, leaving behind the sediment. The sediment was thereafter transferred into a 10 mL test tube and centrifuged at 2000 RPM for 20 minutes. After centrifugation, the supernatant was discarded, and the pellets were again resuspended and centrifuged again [24]. A drop from the suspension was put at the center of a clean grease-free glass slide and a drop of Lugol's iodine was applied to it before gently placing a cover slip on the wet preparation to avoid air bubbles. The individual set up were then examined using the X10 and X40 objective lens of a compound microscope.

Statistical analysis

Statistical analysis was done using IBM SPSS version 21. Analysis of parasites prevalence with respect to individual fruits and was computed using student t-test while the prevalence of parasite contamination between and within samples and selected markets was computed using one way analysis of variance. All analysis were done at 95% confidence interval. Computed p-value greater than 0.05 was determined not to be statistically significant.

RESULTS

Of the one-hundred and eight (108) fruits and vegetables sampled, 27 (25%) were positive for parasite contamination while 81 (75%) were negative (**Table 1**). Also, the frequency of fruits and vegetables contaminated with parasites was significantly lower than the frequency of vegetables and fruits without parasite contamination ($p<0.05$). Of the 27 parasite contaminated fruits and vegetables, Cabbage (29.63%) was the most contaminated, followed by Lettuce (22.22%), Mango (18.52%), Guava (14.81%), Cucumber (11.11%), and Apple (3.70%). Furthermore, 12 (44.44%) of the contaminated fruits and vegetables were purchased from Natako market, 10 (37.04%) were purchased from Kpata market, and 5 (18.52) were purchased from Lokongoma market (**Table 2**). However, there is no significant difference in the prevalence of parasites contaminating different vegetables and fruits ($p>0.05$). From **Table 3**, a total of 4 helminths were isolated as contaminants of fruits and vegetables in Lokoja metropolis. Of these, *Strongyloides stercoralis* (40.74%) was the most prevalent,

followed by *Ascaris lumbricoides* (25.93%), *Trichuris trichiura* (18.52%), and Hookworm (14.81%).

Table 1. Prevalence of parasites on commercially marketed vegetables and fruits.

Samples	Positive n (%)	Negative n (%)	t-value	p-value
Cabbage (18)	8(44.4)	10 (55.6)	6.41767	.000077
Cucumber (18)	3(16.7)	15 (83.3)		
Lettuce (18)	6(33.3)	12 (66.7)		
Mango (18)	5(27.8)	13 (72.2)		
Apple (18)	1(5.6)	17 (94.4)		
Guava (18)	4(22.2)	14 (77.8)		
Total (n = 108)	27(25.0)	81 (75.0)		

n= number

Table 2. Cross-section of parasites on vegetables and fruits with surveyed markets.

Samples	Kpata n (%)	Lokongoma n (%)	Natako n (%)	Total n (%)	*f*-ratio	p-value
Cabbage	3 (37.50)	2 (25.00)	3 (37.50)	8(29.63)	2.67123	.101779
Cucumber	1 (33.33)	0 (0.00)	2 (66.67)	3 (11.11)		
Lettuce	2 (33.33)	2 (33.33)	2 (33.33)	6 (22.22)		
Mango	2 (40.00)	1 (20.00)	2 (40.00)	5 (18.52)		
Apple	0 (0.00)	0 (0.00)	1 (100.00)	1 (3.70)		
Guava	2 (50.00)	0 (0.00)	2 (50.00)	4 (14.81)		
Total (n= 108)	10 (37.04)	5 (18.52)	12 (44.44)	27 (100.00)		

n= number

Table 3. Prevalence of parasites contaminating vegetables and fruit.

Parasite	Frequency	Percentage	p-value
Ascaris lumbricoides	7	25.93	0.235
Hookworm	4	14.81	
Strongyloides stercoralis	11	40.74	
Trichuris trichiura	5	18.52	
Total	27	100	

DISCUSSION

Fruits and vegetables have significant roles in contributing nutrients (such as minerals, vitamins, nutritional fibers) and phytochemicals (especially antioxidants) that defend the body against various infectious and non-infectious diseases [25]. However, despite their immense nutritional values, fruits and vegetables have been globally reported as vehicles for transmitting infectious agents such as gastrointestinal parasites that are of immense public health significance [26,27].

In this study, 25% parasite prevalence was reported in both fruits and vegetables. This is comparable to 24% and 27.5% parasite contamination rates of vegetables and fruits respectively in Anambra State, Nigeria [28]. The parasite contamination rate reported in this study is significantly higher than 2.7% reported in Kerala State, India but lower than 34.4% reported in Damascus, Syria and 35.1% in Southern Thailand [11,29-30]. Furthermore, similar studies have reported significantly higher parasite contamination rates in different parts of Ethiopia [16-17,31-32]. The detection of helminthic ova or cysts on raw vegetables and fruits is of significant public health implication. The fact that these foods are consumed raw by humans and animals shows that they can then serve as passive vehicles for the transmission of pathogenic parasites to humans [33,34].

Ascaris lumbricoides, hookworm, *Strongyloides stercoralis*, and *Trichuris trichiura* were identified on fruits and vegetables in this study. The same organisms were reported as contaminants of fruits and vegetables in Anambra State, Nigeria, and Southern Thailand [11,28]. Sunil *et al* [29] also reported *Ascaris* spp in Kerala State, India and Al-Nahhas and Aboualchamat [30] reported *Ascaris lumbricoides* and *Strongyloides* spp in Damascus, Syria. Similar parasites have been reported in other similar studies [16-17,31-32]. *Strongyloides stercoralis* was the most prevalent parasite in this study. This correlates with the report in Bahir Dar City, Northwest Ethiopia [17]. However, several other studies have reported a higher prevalence of *Ascaris* spp. [16,28-32].

Poor hygienic practices related to planting, harvesting, packing, transportation, and storage can expose vegetables and fruits to be contaminated with parasites of clinical significance [31]. Contamination of fruits and vegetables can occur on field during growth, harvesting, transportation, processing, distribution, and marketing or in homes by food handlers. Contamination of vegetables with these parasites could have resulted from the use of night soil or untreated sewage as fertilizers. Furthermore, ova of *Ascaris* spp. are resistant to many treatments and are often used as a parasitological indicator of contamination and is more prevalent in developing countries [29,35].

Prevention of contamination is the most efficient way to ensure the safety of fruits and vegetables and prevent foodborne parasitic illness. Hence, efforts should be intensified to protect food from primary sources of contamination by washing vegetables, improved hygienic practices of vegetable handlers, improvement in the standards of sanitation, provision of safe and wholesome water for use, and the passage of animals across vegetable farms should be restricted through proper farm fencing. Also, the use of properly treated manure and proper treatment of wastewater used for irrigation of vegetables should be implemented.

CONCLUSION

This study was carried out to determine the prevalence of helminths in commercially marketed vegetables and fruits in Lokoja metropolis. The parasite contamination rate of fruits and vegetables in this study was 25% and the contaminating helminths were *Strongyloides stercoralis*, *Ascaris lumbricoides*, *Hookworm*, and *Trichuris trichiura*. The high prevalence of parasites on vegetables and fruits, that are commonly eaten raw, is of significant public health concern. Hence, vendors of fruits and vegetables need to be properly sensitized on the need to maintain good and standard hygiene and sanitation in every phase in the handling and processing of fruits and vegetables.

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