



## Parasitic Contamination of Fresh Fruits Sold at Fruit Markets in Selected Local Government Areas of Lagos State, Nigeria

K. R. Shonibare <sup>a\*</sup>, A. O. Saba <sup>a</sup>, G. N. Ani <sup>a</sup>, A. A. Olayeri <sup>a</sup>, T. E. Falebita <sup>a</sup>,  
Z. O. Diyaolu <sup>a</sup>, F. O. Alonge <sup>b</sup>, U. O. Jibrin-Yekini <sup>a</sup>, K. E. Iyanda <sup>a</sup>  
and M. A. Azeez <sup>a</sup>

<sup>a</sup> Department of Zoology and Environmental Biology, Faculty of Science, Lagos State University, Ojo, Lagos State, Nigeria.

<sup>b</sup> Department of Botany, Faculty of Science, Lagos State University, Ojo, Lagos State, Nigeria.

### Authors' contributions

This work was carried out in collaboration among all authors. Authors AAO, KRS, AOS, GNA and TEF designed the study. Authors KRS, ZOD, FOA, GNA, KEI, UOJY, AOS, TEF, MAA and AAO conducted the experiments and generated the data. Authors FOA, AAO, GNA and ZOD analyzed the data. Authors KEI, MAA, UOJY, TEF managed the literature searches. Authors KRS, GNA, AAO, AOS and FOA drafted the manuscript. All authors read and approved the final manuscript.

### Article Information

DOI: 10.9734/IJPR/2022/v10i130241

### Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/88806>

Original Research Article

Received 17 April 2022  
Accepted 29 June 2022  
Published 02 July 2022

### ABSTRACT

**Aim:** The purpose of this research was to examine selected fruits sold within the state of Lagos and to assess their level of contamination by parasites.

**Methodology:** It was carried out in Amuwo Odofin, Alimosho and Ojo Local Government Areas of Lagos State between April 2021 and July 2021. A total of hundred fruits were randomly purchased from three markets in the study areas. Samples collected included Apple (*Malus domestica*)(n =20), Grapefruit (*Citrus maxima*)(n =20), Golden melon (*Cucumis melo*)(n =20), Mango (*Mangifera indica*)(n =20), and Pear (*Pyrus communis*)(n =20). Laboratory analysis was done by using a light microscope to examine sediments gotten from washing the fruits with saline solution. Chi-square test of independence was also calculated to determine the relationship between the fruit type and parasite occurrence.

\*Corresponding author: Email: raheemahshonibare@gmail.com;

**Results:** Out of 100 samples collected, 74% were contaminated with 41% having a single contamination while 33% had multiple contamination. The apple was the most contaminated fruit with 85% of the fruit positive while golden melon was the least contaminated as only 60% of the fruit were positive. The parasites identified were *Ascaris lumbricoides* (71%), *Entamoeba histolytica* (18%), *Enterobius vermicularis* (10%), *Giardia lamblia* (16%), Hookworm species (44%), *Strongyloides stercoralis* (4%), *Taenia* species(1%) *Trichuris trichiuria* (11%), and *Toxoplasma gondii* (3%). A chi-square test of independence could not determine any significant relationship between parasite occurrence and market as well as fruit type and parasite occurrence.

**Conclusion:** The percentage of contaminated fruits in this study is high and this is strong evidence that fruit contributes to the spread of parasites within Lagos State. It is recommended that proper sanitation and hygienic practices should be observed from the cultivation of the fruits on the farm till they are put on display at the market. Fruits bought at markets should also be washed properly before consumption.

*Keywords:* Lagos; parasite; tropical; fruit; food.

## 1. INTRODUCTION

Intestinal protozoan parasites and Soil transmitted helminth (STH) diseases have long been a source of concern in the world's poorest communities [1]. Climate, geography, temperature, soil type, and rainfall, as well as poor living and sanitation conditions, all have a part in the spread of these parasites, which is why they are so common in the tropics [2]. STH, which is among the Neglected Tropical Diseases (NTDs), is one of the most common infections worldwide, with over a billion and a half people infected, and as a result, a lot of attention has been paid to them [3]. Nigerians, like those in other tropical nations, have inadequate living conditions and sanitation, which puts them at risk of intestinal parasite diseases. Numerous research conducted throughout the world has revealed that foodstuffs eaten raw and uncooked such as fruits and vegetables, "play an important role in the transfer of these intestinal parasites to humans" [4]. These foods are frequently contaminated during cultivation, harvesting, transportation, processing, or marketing, with the soil, sewage, feces, and contaminated water serving as the primary sources of contamination [5]. Fruits are high in vitamins and minerals, and when consumed, they provide numerous health benefits to man [6]. Fruit intake has been advocated as a result of this fact, as well as the necessity for individuals to have a healthy and balanced diet. While fruits are important as a nutrient source, they can also serve as a potential source of several soil-transmitted helminths and intestinal protozoans when contaminated [2]. There has been no published data on the parasitological contamination of fruits

sold in this part of Lagos State that we are aware of, hence the goal of this study was to identify the common parasites present and analyze the total contamination of chosen fruits sold in Lagos State.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

This study was carried out between April 2021 and July 2021 in three areas of Lagos State (Fig. 1). Lagos is a state in southwestern Nigeria and it is the most populous state in the country. The study areas were Festac which is under Amuwo-Odofin Local Government Area, Iyana-Iba which is under Ojo Local Government Area and Iyana school which is under Alimosho Local Government Area and are situated at 6.2613° N, 3.1652° E; 6.2990° N, 3.1240° E; and 6.2757° N, 3.1210° E respectively.

### 2.2 Sample Collection

A total of hundred fresh fruit samples were randomly collected from three markets in the study areas. Samples collected included Apple (*Malus domestica*)(n =20), Grapefruit (*Citrus maxima*)(n =20), Golden melon (*Cucumis melo*)(n =20), Mango (*Mangifera indica*)(n =20), and Pear (*Pyrus communis*) (n =20). Each sample was placed inside a sterile zip-loc nylon bag to avoid contamination and taken to the laboratory for parasitological screening. Each bag was properly labeled to show the sample type, date, and location.



**Fig. 1. Map showing the location of Lagos State**

### 2.3 Laboratory Investigation

All samples were washed with saline water inside the zip-loc nylon to detach the parasitic stages present in the fruit. The washing solution was transferred immediately into a centrifuge tube (15ml) and was allowed to settle for 24 hours for sedimentation to take place. After sedimentation, the washed solution inside the centrifuge tube (15ml) was centrifuged at 3000 rpm for 5 minutes for the concentration of parasitic stages [7]. The solution was decanted carefully and a drop of Lugol's Iodine Solution was mixed with the resulting sediment. Two drops from the mixed sediment were placed on a clean, sterile, and grease free slide and this was examined under x40, x100 objective lens of a light microscope. A chi-square test was used to determine the association between the occurrence of parasites in the fruit samples and the market they were collected, and to determine the significance between the parasite detected and the fruit type. A *P*-value less than 0.05 was considered significant.

### 3. RESULTS AND DISCUSSION

The 100 fruit samples collected were analysed at Lagos State university Zoology laboratory for parasitic contamination. Protozoans and soil transmitted helminths were detected in 74.0%(74/100) of the samples, out of which 41%

had single infection while 33% had multiple infections (Table 1). Apple had the highest rate of infection (85.0%) while the lowest rate of infection was found in golden melon (60.0%) (Table 1).

The parasites identified were *Ascaris lumbricoides* (71%), *Entamoeba histolytica* (18%), *Enterobius vermicularis* (10%), *Giardia lamblia* (16%), Hookworm species (44%), *Strongyloides stercoralis* (4%), *Taenia* species (1%) *Trichuris trichiuria* (11%), and *Toxoplasma gondii* (3%) with *A. lumbricoides* having the highest prevalence and *Taenia* spp having the lowest prevalence (Table 2).

Parasites were identified in 82.5%, 70.0%, and 65.0% of the fruits obtained from Festac, Iyana-Iba, and Iyana-School markets, respectively (Table 3). In the samples collected at Festac market, apple had the highest rate of contamination (100%) and mango, pear, golden melon had the least contamination rate (75% each) (Table 3). In the samples collected at Iyana-Iba market, apple and mango had the highest number of parasites (87.5%) and golden melon had the lowest number (50%). In the samples collected at Iyana-School market, mango, pear and grapefruit had the highest rate of contamination (75% each) while apple and golden melon had the least contamination rate (50% each) (Table 3).

Table 1. The overall contamination rate of fruits collected

Samples collected	Number of samples examined	Number of positive samples	Number of parasite species			Over all %
			One	Two	Three	
Apple	20	17	7(35%)	8(40%)	2(10%)	85%
Mango	20	16	11(55%)	4(20%)	1(5%)	80%
Pear	20	14	7(35%)	7(35%)	0(0%)	70%
Grape fruit	20	15	9(45%)	6(30%)	0(0%)	75%
Golden melon	20	12	7(35%)	4(20%)	1(5%)	60%
<b>Total</b>	100	74	41(41%)	29(29%)	4(4%)	74%

Total % of multiple contamination is 33%

Table 2. The occurrence of parasites in fruits collected

Parasites detected	Frequency at Festac market	Frequency at Iyana-iba market	Frequency at Iyana-school market	Over all frequency	Over all %
<i>Ascaris lumbricoides</i>	35	27	9	71	71%
<i>Hookworm species</i>	16	20	8	44	44%
<i>Entamoeba histolytica</i>	6	9	3	18	18%
<i>Giardia lamblia</i>	7	8	1	16	16%
<i>Trichuris trichiuria</i>	10	-	1	11	11%
<i>Strongyloides stercoralis</i>	4	-	-	4	4%
<i>Toxoplasma gondii</i>	-	3	-	3	3%
<i>Enterobius vermicularis</i>	4	6	-	10	10%
<i>Taenia spp</i>	1	-	-	1	1%

Table 3. Positivity of fruit samples collected at the markets

Market	Fruits					Total(%)
	Apple	Mango	Pear	Grape	Golden morn	
Festac (n=40)	8 (100%)	6 (75%)	6 (75%)	7 (87.5%)	6 (75%)	33 (82.5%)
Iyana-Iba (n=40)	7 (87.5%)	7 (87.5%)	5 (62.5%)	5 (62.5%)	4 (50%)	28 (70.0%)
Iyana-School (n=20)	2 (50%)	3(75%)	3 (75%)	3 (75%)	2 (50%)	13 (65.0%)

A chi-square test revealed no association between parasite occurrence and market at  $X^2(2, N = 100) = 2.677, (P = .26)$ . There is also no strong evidence to suggest association between fruit type and parasite occurrence at  $X^2(4, N=100) = 3.846, (P = .42)$ .

Fruit consumption contributes to the spread of parasites to man even though they constitute an essential part of our diet and serves as a rich source of vitamins and minerals. This study was conducted to shed more light on the role played by fruits in the transmission of parasites in Lagos State. According to [8], "the rate of contamination

of the environment and foodstuffs with parasites can be linked with the frequency of animals present in the area". Thus contamination in the fruits examined could be due to some bad practices in Nigeria like the use of fecal matter as fertilizer, the use of untreated wastewater for irrigation purposes, and the use of unclean water by some vendors to wash the fruits before selling [9]. It was observed that fruits collected from all markets in the study areas were positive with various protozoan cysts and helminth eggs. Among the nine parasites identified in this study, *A. lumbricoides* had the highest prevalence. This is in line with previous research on fruit

contamination by *A. lumbricoides* in other States of Nigeria [9-12]. This high prevalence of this parasite in the tropics has been associated with poor environmental sanitation and personal hygiene [2]. The total parasitic contamination of this study was 74% and it is in agreement with [13] who had an overall contamination rate of 70% in a study conducted in Brazil. This result is higher and contrary to the results of other studies conducted in other States in Nigeria. The studies of [9] conducted at Oyo State, [14] conducted at Kaduna State, and [15] conducted at Federal Capital Territory, had an overall fruit contamination rate of 48.48%, 35.27%, 42% respectively. It is also higher than in studies conducted in Ethiopia [16] and Poland [8] with an overall fruit contamination rate of 42.6% and 26.9% respectively. The cause of the difference in the overall contamination rate of this present study and studies carried out by others may be a result of the difference in geographical location, type, and the number of samples examined.

#### 4. CONCLUSION

In conclusion, the percentage of contaminated fruits in this study is high and this is strong evidence that fruit assists in spreading these parasites within Lagos State. It is recommended that proper sanitation and hygienic practices should be observed not only during the cultivation of the fruits but during the process of selling them. This is because some of the fruits might have been contaminated during display at the market. The government can help by making policies to guide the production, storage, transportation, and marketing of fruits within the country. The general populace should also be educated about the risk posed by eating contaminated fruits and should ensure all fruits are washed properly before consumption.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Wegayehu T, Tsalla T, Seifu B, Teklu T. Prevalence of intestinal parasitic infections among highland and lowland dwellers in Gamo area, South Ethiopia. *BMC Public Health*. 2013;13:151. DOI: 10.1186/1471-2458-13-151
2. Okwa O. The biology of the tropical parasites. 1st ed. Germany: Lambert Academic Publishers; 2016.
3. World Health Organization. Soil transmitted helminth infections. Fact sheet; 2022. Accessed 10 June 2022. Available: <https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections>.
4. Li J, Wang Z, Karim MR, Zhang L. Detection of human intestinal protozoan parasites in vegetables and fruits: A review. *Parasites Vectors*. 2020;13:380 - 99.
5. Alade GO, Alade TO, Adewuyi IK. Prevalence of intestinal parasites in vegetables sold in Ilorin, Nigeria. *Am-Eurasian J Agric Environ Sci*. 2013; 13(9):1275-82.
6. Olza J, Aranceta-Bartrina J, González-Gross M, Ortega RM, Serra-Majem L, Varela-Moreiras G, et al. Reported dietary intake and food sources of zinc, selenium, and vitamins A, E and C in the Spanish population: findings from the anibes study. *Nutrients*. 2017;9:697.
7. Bakri A, Hussein NM, Ibrahim ZA, Hasan H, Odeh RA. Intestinal parasite detection in assorted vegetables in the United Arab emirates. *Oman Medical Journal*. 2020;35(3):7-12.
8. Klapac T, Borecka A. Contamination of vegetables, fruits and soil with geohelminth eggs on organic farms in Poland. *Annals of Agricultural and Environmental Medicine*. 2012;19(3):421-25.
9. Hassan AA, Ojuromi OT, Onyehialam O. Presence of parasitic ova, cysts and larvae on common fresh fruits and vegetables sold at some major markets in Ibadan, Oyo State, Nigeria. *The Zoologist*. 2013;11:40-45.
10. Uneke CJ. Potential for geohelminth parasite transmission by raw fruits and vegetables in Nigeria: Implication for a risk profile. *J.Nutri.Environ. Med*. 2007;16:59-68.
11. Alli JA, Abolade GO, Kolade AF, Salako AO, Mgbakor CJ, Ogundele MT, et al. Prevalence of intestinal parasites on fruits available in Ibadan markets, Oyo State, Nigeria. *Acta Parasitol. Globalis*. 2011; 2(1):06-10.
12. Ekwunife CA, Akolisa IC. Geo-helminth contamination of some common fruits and vegetables sold in Onitsha urban, south-

- east, Nigeria. The Zoologist. 2009;7:96-101.
13. Santos VH, Borges JM, Santos KS, Sousa BR, Bittencourt FO, Duarte SF, et al. Study of the prevalence of helminths and protozoa in fruits marketed in street markets in a city inside of Bahia. International Journal of Advanced Engineering Research and Science. 2019; 6(5):262-68.
  14. Lawal SB, Wada Y, Ifraimu D. Parasitic contamination of commonly consumed fresh fruits and vegetables sold in open-air markets in Zaria Metropolis, Nigeria. Journal Tropical Bioscience. 2015;10:68-75.
  15. Malann YD and Tim UI. The prevalence of intestinal parasites on fruits sold in markets around Gwagwalada area council, FCT, Abuja. AASCIT communications. 2016; 3(2):107-11.
  16. Bekele F and Shumband T. Fruit and vegetable contamination with medically important helminths and protozoans in Tarcha town, Dawuro zone, South West Ethiopia. Research and Reports in Tropical Medicine. 2019;10:19-23.

---

© 2022 Shonibare et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Peer-review history:*  
*The peer review history for this paper can be accessed here:*  
<https://www.sdiarticle5.com/review-history/88806>