RESEARCH ARTICLE

Sokoto Journal of Veterinary Sciences

(P-ISSN 1595-093X: E-ISSN 2315-6201)

http://dx.doi.org/10.4314/sokjvs.v16i1.11

Patrobas *et al*./*Sokoto Journal of Veterinary Sciences*, **16**(1): 79 - 85.

Occurrence of parasite eggs and oocysts in commonly consumed vegetables collected from selected markets in Zaria, Kaduna State Nigeria

MN Patrobas[1]*, OO Okubanjo[2], IA Lawal[2], CA Kudi[3], AG Balami[4] & HI Dunka[5]

[1.] *Department of Veterinary Parasitology and Entomology, University of Jos, Plateau State, Nigeria*
[2.] *Department of Veterinary Parasitology and Entomology, Ahmadu Bello University, Zaria, Kaduna State, Nigeria*
[3.] *Department Of Veterinary Medicine, Ahmadu Bello University, Zaria, Kaduna State, Nigeria*
[4.] *Department of Veterinary Medicine, University of Maiduguri, Borno State, Nigeria*
[5.] *Department of Veterinary Public Health and Preventive Medicine, University of Jos, Plateau State, Nigeria*

*Correspondence: Tel.: +2348063491795; E-mail: jelbismaryam@gmail.com

Abstract

A study was conducted with the objective of determining the occurrence of parasite eggs and oocysts in washed and unwashed vegetables sold in some selected markets in Zaria, Kaduna State. Cabbage (*Brassica oleracea*), Tomato (*Lycopersicon esculentum*), Lettuce (*Lactuca sativa*), Carrot *(Daucus carota)* and Spinach *(Spinacea oleracea*) were collected based on convenient sampling from 5 markets. Three hundred grams of each vegetable was purchased every week in the morning hours from each of the selected markets during the rainy and dry seasons. Floatation technique was used for processing of the vegetable samples. Unwashed vegetables (269) had more parasite eggs and oocysts than washed vegetables (209). Spinach (52.50%) had the highest contamination, followed by carrot (48.75%), cabbage (42.50%), lettuce (40.0%) and tomatoes (28.75%). There was a significant ($p < 0.05$) association between the occurrence of parasite eggs and oocysts and the washing of vegetables. Among the unwashed vegetables, lettuce was highly contaminated (58.75%) with parasite eggs and oocysts, followed by spinach (55.0%), carrot (55.0%), tomatoes (50.0%) and cabbage (39.75%). There was, however, no significant ($p > 0.05$) association between the occurrence of parasite eggs and oocysts and the unwashed vegetables. Among the different markets, vegetables purchased from Dan Magaji market (51.25%) were highly contaminated, followed by Tudun Wada (49.38%), Sabongari (48.75%), Zaria city (48.75%) and Samaru market (41.88%).There was, however, no significant ($p > 0.05$) association between the occurrence of parasite eggs and oocysts on vegetables and the markets where the vegetables were purchased. The study showed that eggs and oocysts of various parasites mainly of human and animal faecal origin were present on vegetables marketed for human consumption even after washing. Therefore, people should properly wash their vegetables before consumption and indiscriminate defecation should be discouraged to prevent contamination and improve hygienic conditions.

Publication History:
Received: 30-03- 2017
Accepted: 17-11-2017

Keywords: Eggs, Oocyst, Market, Parasite, Vegetable, Zaria

Introduction

Fresh vegetables are regarded as an important part of a healthy diet. Fresh vegetables are essential for good health and they play a major role in the nutritional human diet. They are vital energy contributors that are depended upon by all ages as food supplements or nutrients (Duckworth, 1996). In many countries, such leafy plants are eaten raw or lightly cooked to preserve taste and this may also favor the likelihood of one being infected with food-borne parasites (Ozlem & Sener, 2005).

Consumption of contaminated fruits, vegetables, other food stuff, and water can lead to intestinal parasitic infection (Al-Binali *et al*., 2006). Consumption of contaminated, raw, or undercooked fruits and vegetables is one of the channels through which the spread of intestinal parasitic infections is propagated (Slifko *et al*., 2000). Fruits and vegetables act as a means of spread of parasitic infections when contaminated either in the field, during harvesting, transportation, storage, market chain, or at home (Idahosa, 2011; Omowaye & Abdu, 2012).

The extent of contamination of vegetables depends on several factors such as, use of untreated waste water and water supplies contaminated with sewage for irrigation, post-harvest handling, transportation and unhygienic conditions of preparation in food service or home settings (Simoes *et al*., 2001; Beuchat, 2002; Amoah *et al*., 2007). Post-harvest faecal contamination of vegetables may also occur during handling and transport of vegetables which occur through splashing of contaminated water on vegetables in order to keep the vegetables fresh (Wafa & Almegrin, 2010).

Consumption of vegetables has been a major way of transmitting contaminants, particularly parasitic organisms, leading to the increase of the number of food-borne illnesses (Su *et al.,* 2012).

With the increasing global water scarcity and pollution of water bodies, vegetable farmers resort to the practice of using waste water for irrigating vegetables. Wastewater reuse in agriculture is an ancient practice that has been generally implemented worldwide (Hussain *et al*., 2001). These sources are probably heavily contaminated and may pose a high risk to the health of the farmers and to the consumers if hygienic standards are not maintained.

In most northern part of Nigeria including Zaria, production of vegetables during the dry season is mostly through the traditional (Fadama) system whose main source of water supply and fertilizer is the domestic sewage (Adamu *et al*., 2012). The unhygienic condition of the soil environment which is due to defecation by both human and grazing animals can contaminate water sources. When such contaminated water is used for irrigation of vegetable farms, the produce becomes contaminated as well. The objective, therefore, of the study is to determine the presence of parasite eggs and oocysts in some washed and unwashed vegetables marketed in some selected markets in Zaria, Kaduna State.

Materials and Methods

Study area

The study was carried out in Zaria which is a major city in Kaduna State, Nigeria (Inobeme & Ayanwole, 2009), with a total population of 695,069 (11.5% of the state population) people (NPC, 2006). It is approximated that about 40-75% of its working population derive their principal means of livelihood from agriculture (Nsangu & Redwood, 2009). Horticulture is the second most prevalent agricultural activity in Zaria with vegetables being mostly produced, but in some cases fruits are sandwiched among cereal crops.

Study design

The vegetable samples were purchased from the selected markets as washed (by the retailer) and unwashed vegetables and wrapped in new, sterile, clean polythene bags and transported to the Helminthology laboratory of Ahmadu Bello University, Zaria. In the laboratory, each of the vegetable samples both washed and unwashed were weighed appropriately. The washed and unwashed vegetable samples were washed in clean plastic containers, processed and examined immediately. In addition, the same vegetable samples were soaked, processed and examined after 24 hours.

Sample size

The sample size was determined according to Mugo (2008) using the formula:

$$N=\frac{Z^2Pq}{d^2}$$

z= appropriate value for the standard normal deviation for the desired confidence 1.96

p= prevalence which is 57.8% (Maikai *et al*., 2012)

q=1-p

d= desired absolute precision=0.05

$$N=\frac{1.96 \times 0.578 \times (1-0.578)}{0.05^2}$$

$$= \frac{0.9370}{0.0025}$$

$$= 374.81$$

However, 400 samples each were collected during the rainy and dry periods, respectively.

Market and sample selection

Samples were collected from five selected main vegetable markets within Zaria. They included Dan Magaji, Zaria City, Tudun Wada, Sabon Gari and Samaru markets.

Five types of vegetables were selected (based on availability and rate of consumption) for this study. These include; Cabbage (*Brassica oleracea*), Tomato (*Lycopersicon esculentum*), Lettuce (*Lactuca sativa*), Carrot *(Daucus carota)* and Spinach *(Spinacea oleracea*). Vegetables were collected based on convenient sampling from retailers in the markets.

Vegetable sample collection

Three hundred grams of each vegetable was purchased every week in the morning hours from each of the selected markets during the rainy and dry seasons. The samples were then transported to the Helminthology Research Laboratory in the Department of Veterinary Parasitology and Entomology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria in sealed, well-labelled, new and clean polythene bags.

Sample analysis

Floatation technique for immediate processing of vegetable samples: A modification of the method by Abougrain *et al*. (2010) and Bailenger (1962), was used. Each vegetable sample was weighed (250g) and washed in distilled water (1500 mls) in a plastic container. The wash was left in the plastic container for 10 hours to sediment. The supernatant was discarded and the residue was transferred into the centrifuge tube and spun at 1500g for 5 minutes.The supernatant was discarded and the residue was agitated gently in sucrose floatation medium of 1.21 specific gravity and then sieved through a gauze placed on a funnel in a test-tube. Each test-tube was topped to the brim with the floatation media to form a convex meniscus. A cover slip was placed on the test tube for 3 minutes and this was removed and placed on a clean glass slide and viewed under the microscope using ×40 and ×10 objectives for the presence of parasite eggs and oocysts.

Floatation technique for 24 hours processing of vegetable samples: A modification of the method by Abougrain *et al*. (2010) and Bailenger (1962), was used as follows. Each vegetable sample was weighed (250g) and soaked in distilled water (1500mls) in a plastic container for 24 hours. After 24 hours, the vegetables were removed and the wash was left in the plastic container for 10 hours to sediment. The supernatant was discarded and the residue was transferred into the centrifuge tube and spun at 1500g for 5 minutes. The supernatant was discarded and the residue was agitated gently in sucrose floatation medium of specific gravity 1.21 and then sieved through a gauze placed on a funnel in a test tube. Each test tube was topped to the brim with the floatation media to form a convex meniscus. A cover slip was placed on the test tube for 3 minutes and this was removed and placed on a clean glass slide and viewed under the microscope using ×40 and ×10 objectives for the presence of parasite eggs and oocysts.

Data analysis

Data was analysed using SPSS version 17 (Inc. Chicago, USA). Data obtained were reduced into percentages and summarized into tables and charts. Chi-square was used to test for association between the occurrence of parasite eggs and oocysts on vegetables in different markets and factors such as types of vegetables, markets and period of sampling. Values of $P \leq 0.05$ were defined as significant.

Results

Occurrence of parasite eggs and oocysts on the different vegetable type

The level of contamination varied with vegetable types, Spinach had the highest parasite egg and oocysts contamination (53.75%), followed by carrot (51.88%), lettuce (49.38%), cabbage (45.63%) and tomatoes (39.38%). However, there was no statistical significant ($p > 0.05$) association between the occurrence of parasite eggs and oocysts and the vegetable types (Table 1).

Occurrence of parasite eggs and oocysts on the different types of washed and unwashed vegetables

Unwashed vegetables 214 (53.50%) had more parasite eggs and oocysts when compared to washed vegetables 170 (42.50%). Among washed vegetables, spinach (52.50%) harboured more parasite eggs and oocysts followed by washed carrot (48.75%). Unwashed lettuce (58.75%) had more

Table 1: Occurrence of parasite eggs and oocysts on vegetable types

Vegetable	Total number	No positive for parasites (%)	Washed vegetables positive n= 80, (%)	Unwashed vegetables positive n= 80, (%)	Chi square (χ^2) and P value
Tomatoes	160	63 (39.38)	23 (28.75)	40 (50.0)	* χ^2 = 8.33
Spinach	160	86 (53.75)	42 (52.50)	44 (55.0)	P = 0.801
Carrot	160	83 (51.88)	39 (48.75)	44 (55.0)	** χ^2 = 10.95
Cabbage	160	73 (45.63)	34 (42.50)	39 (48.75)	P = 0.0272
Lettuce	160	79 (49.38)	32 (40.0)	47 (58.75)	*** χ^2 = 2.151
					P = 0.7081
Total	800	384 (48)	170 (42.50)	214 (53.50)	

Note: *Chi square for positive parasites on vegetables
**Chi square for positive parasites on washed vegetables
*** Chi square for positive parasites on unwashed vegetables

Table 2: The Occurrence of parasite eggs and oocysts based on markets where the vegetables were purchased in Zaria

Markets	Total number	Number positive (%)	Number positive for washed vegetables	Number positive for unwashed vegetables	Chi square (χ^2) and P value
Dan magaji	160	82(51.25)	34	48	* χ^2 = 3.275
Zaria city	160	78(48.75)	36	42	P = 0.5129
Tudunwada	160	79(49.38)	38	41	** χ^2 = 1.680
Sabongari	160	78(48.75)	32	46	P = 0.7943
Samaru	160	67(41.88)	30	37	*** χ^2 = 3.480
					P = 0.4810
Total	800	384(48)	170	214	

Note:* Chi square for positive vegetables in the markets
** Chi square for positive washed vegetables in the markets
*** Chi square for positive unwashed vegetables in the markets

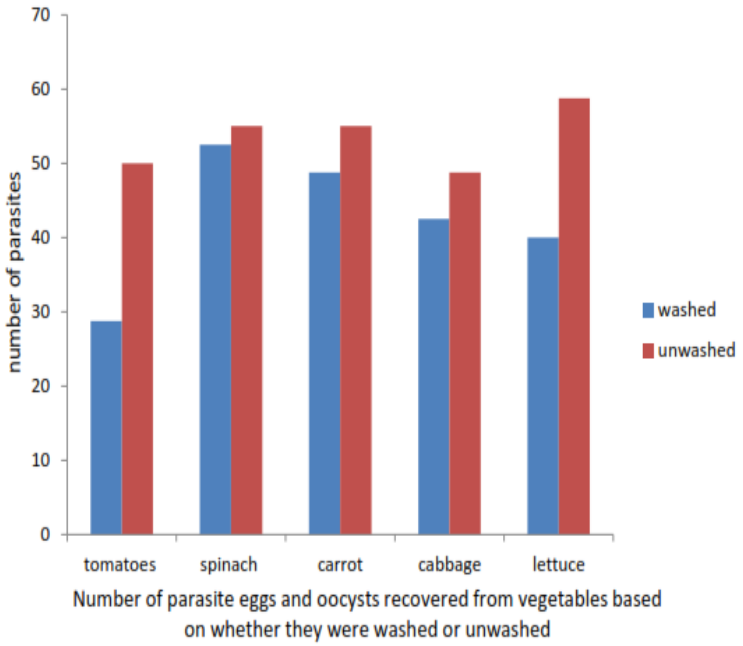

Figure 1: Number of parasite eggs and oocysts recovered from vegetables based on whether they were washed or unwashed

parasite eggs and oocysts, followed by unwashed spinach (55.0%) and unwashed carrots (55.0%) (Table 1).

Occurrence of parasite eggs and oocysts on the different types of washed vegetables

Spinach (52.50%) had the highest parasite eggs and oocysts contamination, followed by carrot (48.75%), cabbage (42.50%) then lettuce (40.0%). Tomatoes, however, had the least contaminated (28.75%). There was a significant ($p < 0.05$) association between the occurrence of parasite eggs and oocysts and the washed vegetables (Table 1).

Occurrence of parasite eggs and oocysts on the different type of unwashed vegetables

Among the unwashed vegetables,

lettuce was highly contaminated (58.75%) with parasite eggs and oocysts, followed by spinach (55.0%) and carrot (55.0%), then tomatoes (50.0%). While cabbage (39.75%) was least contaminated. There was however, no significant ($p > 0.05$) association between the occurrence of parasite eggs and oocysts and the unwashed vegetables (Table 1).

The occurrence of parasite eggs and oocysts based on the markets

The study showed that vegetables purchased from Dan Magaji market (51.25%) were highly contaminated with parasite egg and oocysts, followed by those purchased from Tudun Wada (49.38%), Sabongari (48.75%) and Zaria city (48.75%) markets. Vegetables purchased from Samaru market (41.88%) were the least contaminated with parasite eggs and oocysts. There was however, no significant ($p > 0.05$) association between the occurrence of parasite eggs and oocysts on vegetables and the markets where the vegetables were purchased (Table 2).

Discussion

It was established from the result that washed vegetables still had a lot of parasite eggs and oocysts. This may be due to the use of contaminated water in washing the vegetables and the use of the same container and water to wash the different types of vegetables. It could also be due to sprinkling or splashing of contaminated water to keep the vegetables moist and fresh (Al=Megrin, 2010).

There was a significant association between the occurrence of parasite eggs and oocysts and the washing of vegetables. This was as a result of the significant reduction in parasite eggs and oocysts after washing of tomatoes which showed that washing had an effect on tomatoes which could be as a result of the fresh, smooth, leathery surface which tend to reduce rate of parasitic attachment (Mba, 2000).

Based on vegetable types, spinach (*Spinacia oleracea*) commonly called "aleho" in the local parlance, was found to have the highest occurrence of parasite eggs and oocysts. This agrees with the findings of Uga *et al*. (2009) and Maikai *et al.* (2012). Uga *et al*. (2009) showed that contamination is usually high in leafy vegetables followed by root and fruity vegetables. Spinach is a readily available and affordable vegetable compared to the other types of vegetables in the study area. The high occurrence of parasite eggs and oocysts on spinach persisted in washed vegetables while it was found second to lettuce in the unwashed vegetables. Vegetables like lettuce have broadleaves and large surface areas which are in direct contact with the sewage contaminated soil surface (Larkin *et al.*, 1978) and organic debris or due to the method of harvest. Cabbages have rough uneven surfaces that make parasite eggs and oocysts attach themselves easily to the surfaces of the vegetables either on the farm or when washed with contaminated water (Mara & Cairncross, 1989). Fresh vegetables like tomatoes have smooth leathery surfaces which tend to reduce the rate of parasitic attachment (Mba, 2000). However, there was no significant difference between occurrence of parasite eggs and oocysts for both washed and unwashed vegetables.

This study also showed that vegetables purchased from Dan-magaji market had higher occurrence of parasite eggs and oocysts (51.25%) followed by Tudun-wada (49.38%), Zaria city and Sabongari (48.75%) while Samaru market had the least parasite eggs and oocysts occurrence at 41.88%. This is in contrast to Maikai *et al. (*2012) who showed that vegetables from Sabongari market had the highest contamination. The differences observed may be attributed to the fact that Maikai *et al*. (2012) did not include Dan-Magaji and Tudun-Wada markets in their study and hence may not have observed the occurrence above. Also, it had been observed that there was no potable water supply in Dan-Magaji and Tudun-Wada markets and these vegetables were washed with water from wells and water from water vendors in which the sources are unknown. The contamination may also be due to the poor hygienic practices in the markets, decreased level of health education of the retailers on the market product presentation and handling. Environmental factors may also play a role in the observed difference due to the fact that in some of these vegetable markets, there is unhygienic handling of vegetables by retailers who display their vegetables on the ground as observed during purchases which may have exposed the vegetables to direct contact with the soil and contaminants. Samaru market had the least contamination and may be due to the fact that it is located close to an academic environment with hygiene conscious individuals and also some of these retailers have some level of education.

Acknowledgement

The authors would like to acknowledge the effort of Dr. Chiedebere Uchendu for his technical assistance on the statistical analysis of the data.

References

Abougrain AK, Nahasi MH, Madi NS, Saied MM & Ghenghesh KS (2010). Parasitological contamination in salad vegetables in Tripoli-Libya. *Journal of Food Control*, **21**(5): 760-762.

Adamu NB, Adamu JY & Mohammed D. (2012). Prevalence of helminth parasites found on vegetables sold in Maiduguri ,Northeastern Nigeria. *Food Control*, **25**(1): 23-26.

Al-Binali AM, Bello CS, El-Shewy K & Abdulla SE (2006). The prevalence of parasites in commonly used leafy vegetables in South Western, Saudi Arabia. *Saudi Medical Journal*, **27**(5): 613-616.

Al-Megrin WAI (2010). Prevalence of intestinal parasites in leafy vegetables in Riyadh, Saudi Arabia. *International Journal of Zoological Research*, **5**(2): 20-23.

Amoah P, Dreshsel P, Abaidoo RC & Klutse A (2007). Effectiveness of common and improved sanitary washing method in selected cities of West Africa for the reduction of coliform bacteria and helminth eggs on vegetables. *Tropical Medicine and International Health*, **12**(s2): 40-50.

Bailenger J (1962). Valeur compare des ethodes d'enrichissement encoprologie prarasitaire. *Pharmaceutical Biology*, **3**: 249-259.

Beuchat LR (2002). Ecological factors influencing survival and growth of human pathogens on raw fruits and vegetables. *Microbes and Infections*, **4**(4): 413-423.

Duckworth RB (1996). Farming Systems for the Production of Fruits and Vegetables. In: *Fruits and Vegetables.* Oxford, Pergamon Press. Pp 48-62.

Hussain I, Raschid L, Hanjra M, Marikar F & Van der Hoek W (2001). A framework for analyzing socioeconomic, health and environmental impacts of wastewater use in agriculture in developing countries. Working Paper, Vol. 26. Colombo, Sri Lanka: International Water Management Institute (IWMI). Pp 23.

Idahosa OT (2011).Parasitic contamination of fresh vegetables sold in Jos Markets. *Global Journal of Medical Research*, **11**(1):21-25.

Inobeme J & Ayanwole AK (2009). An assessment of the spatial distribution of government secondary schools in Zaria area, Kaduna State, *The Information Manager*, **9**(1): 1-9.

Larkin E P, Tieney JT, Lovett J, Van Donsel D, Francis D & Jackson GJ (1978). Land Application of Sewage Waste: Potential for Contamination of Foodstuffs and Agricultural Soils by Viruses, Bacterial Pathogens and Parasites. In: *State of Knowledge in Land Treatment of Wastewater* (HL Mc Kim. editor), International Symposium August 20-25, Hanover, NH,: US Army Corps of Engineers. Pp 215-223.

Maikai BV, Elisha IA & Baba-Onoja EBT (2012). Contamination of vegetables sold in markets with helminth eggs in Zaria metropolis, Kaduna State, Nigeria. *Food Control*, **28**(2): 345-348.

Mara D & Cairncross CS (1989). Guidelines for the Safe Use of Waste Water and Excreta in Agriculture and Aquaculture, Measures for Public Health Protection. Water and Sanitation Health (WSH). WHO Geneva. Pp 21-187.

Mba OO (2000). Detection and enumeration of parasite eggs in irrigated vegetables and salad crops in Plateau State, Nigeria. *Journal of Medical Laboratory Science,* **9**: 30-36.

Mugo FW (2008). Sampling in Research. http://www.socialresearchmethods.net/Mugo/tutorial.htm, retrieved 10-06-2011.

NPC (National Population Commission). (2006). Federal Republic of Nigeria official NBS Federal Republic of Nigeria Official gazzette Lagos, Nigeria. No 96(2).

Nsangu CA & Redwood M (2009). Urban Agriculture and Physical Planning: A case study of Zaria Nigeria. In: *Agric Urban Planning General livelihood, Food Security*. Taylor and Francis, New York, NY 10017. Pp 217.

Omowaye OS & Abdu, PA (2012). Parasites contamination and distribution on fruits and vegetables in Kogi, Nigeria. *Cibtech Journal of Bio-Protocols,* **1**(1): 44–47.

Ozlem E & Sener H (2005). The contamination of various fruits and vegetables with *Enterobius vermicularis*, Ascaris eggs, *Entamoeba histolytica* cysts and *Giardia lamblia* cysts*. Journal of Food Control*, **16**: 557-560.

Simeos M, Pisani B, Marques EG L, Prandi MAG, Martini MH & Chiarini PFT (2001). Hygienic sanitary conditions of vegetables and water from kitchen garden in the municipality of

Campinas. *Brazilian Journal of Microbiology*, **32**(4): 331-333.

Slifko TR, Smith HV & Rose JB (2000). Emerging parasite zoonoses associated with water and food. *International Journal of Parasitology*, **30**(12-13): 1379-1393.

Su C, Khan A, Zhou P, Majumdar D, Ajzenberg D, Darde ML & Sibley LD (2012). Globally diverse *Toxoplasma gondii* isolates comprise six major clades originating from small number of distinct ancestral lineages. *Proceedings of the National Academy of Science*, **109**(15): 5844-5849.

Uga S, Hoa NTV, Noda S, Moji K, Cong L, Aoki Y, Rai SK & Fujimaki Y (2009). Parasitic egg contamination of vegetable from sub-urban market in Hanoi, Vietnam. *Nepal Medical College Journal*, **11**(2): 75-78.

Wafa AI & Al-megrin (2010). Prevalence of intestinal parasites in leafy vegetables in Riyadh, Saudi Arabia. *International Journal of Zoological Research*, **6**(3): 190-195.