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The presence of intestinal parasites in selected vegetables from open markets in south western Nigeria

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Summary

Intestinal parasitic infections are among the most common infection worldwide. In recent years there has been an increase in the number of reported cases of food-borne illness linked to fresh vegetables which is a major way in the transmission of intestinal parasites. The study was carried out to determine the level of parasitological contamination of vegetables sold at selected markets in south western Nigeria. A total of 120 samples from different vegetables were randomly sampled from major selected open markets in 3 cities. The vegetables were analysed using macroscopic, sedimentation and magnesium sulphate floatation techniques. Eighty-two (68.3%) of the vegetables were positive for intestinal parasites from which water leaf (*Talinium triangulare*) and 'soko' (*Celosis*) recorded the highest (100%) parasitic contamination. Parasites detected were *Ascaris lumbricoides* (16.7%), hookworm (18.3%), *Taenia* spp (4.2%), *Strongyloides stercoralis* (45.8%), *Balantidium coli* (0.8%). Vegetables in each of these cities had almost the same high rate of parasitic contamination; Ibadan (70%), Ilorin (70%) and Lagos (65%). This study further emphasised the role of vegetables in the transmission of intestinal parasites in developing countries. Therefore, vegetable farmers should therefore be enlightened on the modern use of night soil as fertilizer and the treatment of irrigation water or municipal waste water before use. There is also dire need for the improvement of sanitary facilities in our markets and vegetable vendors should also be included in the screening of food handlers.

Keywords: *Intestinal Parasites, vegetables, Market and South western Nigeria*

Résumé

Les infections parasitaires intestinales sont parmi les infections les plus communes du monde. Ces dernières années, il y'a eu une augmentation du nombre de cas reportes d'intoxication liées aux légumes qui sont les moyens majeurs de transmission des parasites intestinaux. Cette étude était faite pour déterminer le niveau de contamination parasitologique des légumes vendus dans quelques marches sélectionnés au sud Ouest du Nigéria. Un total de 120 échantillons de différents légumes était collecté dans certains marches de 3 villes. Les légumes étaient analyses a l'aide des techniques macroscopiques de sédimentation. 82(68.3%) des légumes étaient positifs aux parasites intestinaux parmi lesquels le "waterleave" (Talinium triangulaire) et le "*soko*" *(célosie)* démontraient la plus forte contamination parasitaire (100%). Les parasites détectés étaient Ascaris lombricoïdes (16.7%), les amibes (18.3%), le ténia spp (4.2%),strogyloides stercorales (45.8%), bolantidium coli (0.8%). Les légumes dans chacune de ces villes avaient Presque le même taux de contamination parasitaire; Ibadan (70%),ilorin (70%) et Lagos (65%). Cette étude a plutard montre le rôle des légumes dans la transmission des parasites intestinaux dans les pays en développement. Cependant, les techniques modernes d'utilisations des engrais doivent être enseignés aux agriculteurs ainsi que le traitement des eaux d'irrigation. Il y'a aussi un besoin essentiel d'une amélioration des facilites sanitaires dans nos marchés, et les vendeurs de légumes doivent être impliques dans la sensibilisation.

Introduction

The role of fresh vegetables in nutrition and healthy diets are well recognised. Vegetables are an important source of nourishment and a vital ingredient in healthy and balance diets. Fresh vegetables and fruits are highly recommended in any diet, virtually without quantitative restriction [1]. However, problems linked with pathogens in fresh foods, including the associated public health and trade implications, have been reported in a number of countries worldwide [2, 3]. Various parasites that have been associated with vegetables include species of protozoan [3, 4] and helminthes [5-7]. Common food-borne parasites

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include three types of worms and several protozoa. The worms include tapeworms (cestodes), flukes (trematodes and roundworm (nematodes).

Processing, conservation, distribution and trading have made nearly all kinds of fresh vegetables available and methods employed have increased health hazards, mainly associated with pathogenic microorganisms [8]. Several outbreaks of gastroenteritis have been traced to the consumption of contaminated fresh vegetables [9, 10, 11]. Food-borne parasites have received little attention in developing countries [1]. As a result, these organisms infest vegetables while still in the field, and are usually contaminated by wash water and spread by ineffective hygiene practices [1]. When the soil becomes contaminated, the eggs in soil can be transferred onto vegetables then onto the hands and transferred directly into the mouth [12] or ingested by eating raw vegetables [9]. Intestinal parasites have been found to adhere to vegetables, fruits, fingers, utensils, and money [13].

Control of protozoans and helminthes is a constant object of public health strategies, especially where reclaimed water is used. The resistant cysts and eggs of these parasites enhance their survival in the natural environment. To our knowledge, there are little or no previous studies that have examined the contamination of vegetables in south western Nigeria. We however determined the level of parasitological contamination of vegetables sold in some major open markets in south western part of Nigeria.

Materials and methods

Sample Collection

Vegetables were collected from four different open markets in each of three capital cities (Ilorin, Ibadan and Lagos) in Nigeria. The study was carried out between January and October, 2008. Ten varieties of common vegetables were collected from each of these markets. The vegetables were tomatoes (*Lycopersicum sativus*), carrots (*Daucus carota*), cabbage (*Brassica deracea*), cucumber (*Cucumis sativa*), 'ewedu' (*Corchorus olitorius*), water leaf (*Talinium triangulare*), 'soko' (*Celosis*), 'ugwu' (*Telfairia occidentalis*), 'tete' (*Amaranthus*), and water melon (*Citrullus lanatus*). The vegetables were chosen because they are more consumed by the residents in these communities.

Sedimentation technique

A 250 g sample of each vegetable was washed in distilled water in a plastic container for the removal of the parasitic ova, larva, or cysts, after they had been examined macroscopically for the presence of segment of cestodes and adult nematodes. The suspension was strained through a sterile sieve to remove undesirable materials [10]. The filtrate was centrifuged at 5000 rpm for 5 minutes [14]. The supernatant was discarded and the sediment was examined after thorough and gentle mix.

Floatation technique

The deposit obtained above was re-suspended in magnesium sulphate floatation fluid and re-centrifuged. The floatation fluid was filled to the brim and a cover slip was superimposed and this was lifted and examined under the microscope [10].

Statistical analysis

Data was computed using simple percentages while Chi square was used for test of significance of the two techniques.

Results

A total of 120 samples were examined for intestinal parasites; 10 different types of vegetables were sampled in each of the four markets in the cities. The macroscopic examination showed no presence of parasites. In the microscopic analysis (sedimentation and floatation techniques) 82 (68.3%) of the 120 vegetables had intestinal parasites. Eleven (91.7%) of 'ewedu' (*Corchorus olitorius*), 12 (100%) of 'soko' (*Celosis*), 10 (83.3%) of 'tete' (*Amaranthus*), eight (66.7%) of 'ugwu' (*Telfairia occidentalis*), 11 (91.7%) of tomatoes (*Lycopersicum sativus*), five (41.7%) of cabbage (*Brassica deracea*), 12 (100%) of water leaf (*Talinium triangulare*), four (33.3%) of cucumber (*Cucumis sativa*), eight (66.7%) of carrot (*Daucus carota*) and one (8.3%) of water melon (*Citrullus lanatus*) had intestinal parasites. The prevalence of intestinal parasites in vegetables sampled from each city; Ibadan, Ilorin and Lagos are also shown (Table 1). The highest prevalence was found in water leaf and 'soko,' both having 100% from all the selected markets in the 3 cities, while the lowest parasitic contamination was reported in water melon, also in all the cities. Ilorin had 25% contamination while Ibadan and Lagos had none.

The distribution of intestinal parasites isolated from the various open markets is shown in Table 2. Markets sampled in Ibadan include Bodija, Oja-Oba, Oje, and Gate. Vegetables sampled from Oje market had highest prevalence of parasitic contamination (90%); Oja-Oba (80%); Bodija (70%) while Gate had the lowest (40%). From Ilorin markets, Ipata

Table 1: Prevalence of intestinal parasites in vegetable samples from each state.

Vegetables	N	Ibadan	n	Ilorin	n	Lagos	Total
Ewedu (*Corchorus Olitorius*)	4	4 (100)	4	3 (75)	4	4 (100)	11 (91.7)
Tete (*Amaranthus*)	4	3 (75)	4	3 (75)	4	4 (100)	10 (83.3
Cabbage (*Brassica deracea*)	4	2 (50)	4	2 (50)	4	1 (25)	5 (41.7)
Cucumber (*Cucumis sativa*)	4	1 (25)	4	2 (50)	4	1 (25)	4 (33.3)
Water leaves (*Talinium triangulare*)	4	4 (100)	4	4 (100)	4	4 (100)	12 (100)
Tomatoes (*Lycopersicum sativus*)	4	4 (100)	4	3 (75)	4	4 (100)	11 (91.7)
Shoko (*Celosis*)	4	4 (100)	4	4 (100)	4	4 (100)	12 (100)
Ugwu (*Telfairia occidentalis*)	4	3 (75)	4	3 (75)	4	2 (50)	8 (66.7)
Carrot (*Daucus carota*)	4	3 (75)	4	3 (75)	4	2 (50)	8 (66.7)
Water melon (*Citrullus lanatus*)	4	0 (0)	4	1 (25)	4	0 (0)	1 (8.3)
Total	40	28 (70)	40	28 (70)	40	26 (65)	82 (68.3)

( ): Number in parenthesis is percentage
n = Frequency

Table 2: Distribution of intestinal parasites isolated from four open markets in each state

Vegetables	Ibadan Markets					Ilorin Markets				Lagos Markets		
	Bodija	Oja-oba	Oje	Gate	Ipata	Oja-oba	Unity	Oja-tuntun	Ketu	Mile 12	Ikorodu	Mile 2
Ewedu (*Corchorus Olitorius*)	A	B, D	D	D	C, D	D	D	*	D	B, D	D	B, D
Tete (*Amaranthus*)	A	D	D	*	B, D	A	D	*	D	A	D	D
Cabbage (*Brassica deracea*)	*	D	D	*	A	*	*	A	*	D	*	*
Cucumber (*Cucumis sativa*)	*	*	B	*	A, D	*	*	A	*	D	*	*
Water leaves (*Talinium triangulare*)	D	B	B, D	D	C, D	A, D	C, D	D	D	D	D	B, D
Tomatoes (*Lycopersicum sativus*)	B	B, D	D	D	B	A, B	D	*	A	B, D	D	D
Shoko (*Celosis*)	E	A, B	D	D	A, B	B, D	D	D	B	A, D	B, D	A, D
Ugwu (*Telfairia occidentalis*)	D	D	D	*	A, B, D	D	*	A	B	D	*	*
Carrot (*Daucus carota*)	C	D	D	*	A	A	*	C	A	D	*	*
Water melon (*Citrullus lanatus*)	*	*	*	*	B	*	*	*	*	*	*	*
Total	7(70)	8(80)	9(90)	4(40)	10(100)	7(70)	5(50)	6(60)	7(70)	9(90)	5(50)	5(50)

*A = ova of A. lumbricoides, B = ova of Hookworm, C = ova of Taenia spp, D = Strongyloides stercoralis, E = Balantidium coli, * = no parasite seen, ( ) = Number in parenthesis is percentage*

had the highest occurrence of 100%; Oja-Oba (70%); Oja tuntun (60%) and Unity (50%). In Lagos markets, Mile 12 had the highest (90%); Ketu (70%) while Ikorodu and Mile 2 markets had 50% each. It is noteworthy that mixed parasites were found on these vegetables.

Table 3 shows the overall frequency of intestinal parasites in vegetables. The most frequently isolated parasite from all samples was *Strongyloides stercoralis* (45.8%) while *Balantidium coli* had the lowest (0.8%). The frequency of isolation of parasites from different cities is as shown in Table 4.

Sedimentation and floatation techniques (by magnesium sulphate) were used for recovery of ova of parasites. Sedimentation technique recovered the highest number of parasites 87 (84.5%) while floatation technique recovered only 16 (15.5%). Significant difference was found between these techniques; $P = 0.00001$, $P < 0.05$.

Table 3: The frequency of intestinal parasites isolated from 120 vegetables

Parasites	Frequency of isolation
Ascaris lumbricoides	20 (16.7)
Hookworm	22 (18.3)
Taenia spp	5 (4.2)
Strongyloides stercoralis	55 (45.8)
Balantidium coli	1 (0.8)
Total	103 (85.8)

( ): Number in parenthesis is percentage

with more than one parasite; water leave (*Talinium triangulare*) and 'soko' (*Celosis*) recorded highest parasitic contamination (100%). Water melon (*Citrullus lanatus*) had lowest contamination (8.3%). In the previous study of Nyarango *et al.* in Kenya, a similarly high prevalence of parasitic infestation was obtained from vegetables; 65.5%. These vegetables include kales, cabbage, spider flower and black nightshade [10]. However, in the study of Damen *et al.* carried out in Jos, Nigeria, which is northern part of the country 36% was

Table 4: Frequency of parasites isolated in vegetables from different locations; Ibadan, Ilorin, and Lagos.

Location	Parasites Isolated	Vegetables										
		Ewedu	Tete	Cab-bage	Cucu-mber	Water leaf	Toma-toes	Shoko	Ugwu	Car-rot	Water melon	Total
Ibadan	*A. lumbricoides*	1(25)	1(25)	-	-	-	-	1(25)	-	-	-	3(7.5)
	Hookworm	1(25)	-	-	1(25)	2(50)	2(50)	1(25)	1(25)	-	-	8(20)
	Taenia spp	-	-	-	-	-	-	-	-	1(25)	-	1(2.5)
	S. stercoralis	3(75)	2(50)	2(50)	-	3(75)	3(75)	2(50)	2(50)	2(50)	-	19(47.5)
	B. coli	-	-	-	-	-	-	1(25)	-	-	-	1(2.5)
Ilorin	*A. lumbricoides*	-	1(25)	2(50)	2(50)	1(25)	1(25)	1(25)	2(50)	2(50)	-	12(30)
	Hookworm	-	1(25)	-	-	-	2(50)	2(50)	1(25)	-	1 (25)	7(17.5)
	Taenia spp	1(25)	-	-	-	2(50)	-	-	-	1(25)	-	4(10)
	S. stercoralis	3(75)	2(50)	-	-	4(100)	1(25)	3(75)	2(50)	-	-	15(37.5)
	B. coli	-	-	-	-	-	-	-	-	-	-	0 (0)
Lagos	*A. lumbricoides*	-	1(25)	-	-	-	1(25)	2(50)	-	1(25)	-	5(12.5)
	Hookworm	2(50)	-	-	-	1(25)	1(25)	2(50)	1(25)	-	-	7(17.5)
	Taenia spp	-	-	-	-	-	-	-	-	-	-	0(0)
	S. stercoralis	4(100)	3(75)	1(25)	1(25)	4(100)	3(75)	3(75)	1(25)	1(25)	-	21(52.5)
	B. coli	-	-	-	-	-	-	-	-	-	-	0(0)

( ): Number in parenthesis is percentage

Table 5: Prevalence of intestinal parasites with the techniques used.

Parasites	Sedimentation method	Floatation method
A. lumbricoides	14 (70)	6 (30)
Hookworm	12 (57.1)	9 (42.9)
Taenia spp	5 (100)	-
S. stercoralis	55 (98.2)	1 (1.8)
B. coli	1 (1.2)	-
Total	87 (84.5)	16 (15.5)

( ): Number in parenthesis is percentage

Discussion

One hundred and twenty vegetables were sampled from different geographical locations in south western Nigeria: Ibadan, Oyo state; Ilorin, Kwara state; Lagos, Lagos state. The overall prevalence of intestinal parasites from the vegetables was 82 (68.3%), however there were mixed vegetable infestations recorded [14]. The very high difference in the prevalence is not unconnected with the difference in the climatic conditions in these regions. The north is characterised with dry and hot weather with little rainfall hence little or no dense forest with environmental and climatic condition that do not allow the survival and growth of these parasites.

Vegetables in each of the cities sampled had almost the same rate of parasitic contamination, Ibadan (70%); Ilorin (70%); Lagos (65%). This may not be unconnected to the similar practice of using contaminated surface water for irrigating the vegetables, these rivers or streams are probably heavily contaminated by faecal materials. The direct application of night soil, animal manure and waste water as an agricultural fertilizer is the usual practice in many parts of the developing countries especially the sub-Saharan Africa [9]. Also, these cities are from the same geographical area with the same climatic conditions that favour the survival of the parasites,

coupled with poor drainage and sanitary facilities which is characterised by the presence of refuse dump sites near or in the markets. The handling techniques of these vegetables have also been attributed to their contamination [9]. As a rule, these organisms infest vegetables while still in the field, and are usually transmitted by contaminated wash water and spread by ineffective hygienic practices [1]. Previous study has shown that vegetables purchased at urban markets have been found to have higher rates of infestation with intestinal parasites [15]. Population size, density, and socio-economic conditions also contribute to the development and transmission of many intestinal parasites. The risk of infection with intestinal parasites to the population is increased because these contaminated vegetables are sometimes eaten raw, undercooked to retain the natural taste and preserve heat-labile nutrients. Also, contamination by ineffective hygiene practices by the vegetable vendors can not be ruled out with the standard of facilities in our open markets.

Five different parasites were isolated from the vegetables; *Ascaris lumbricoides*, Hookworm, *Taenia* spp., *Strongyloides stercoralis*, and *Balantidium coli*. The most common parasite isolated was *S. stercoralis* (45.8%) while *B. coli* (0.8%) was least isolated. Some of the parasites isolated in this study have been reported by other authors; *Ascaris lumbricoides* [16, 17, 14, 10], Hookworm [17, 14, 10], *Taenia* spp. [16], *S. stercoralis* [14], *B. coli* [10]. The highest health risk is for acquisition of helminthes infections, when compared with other pathogens, because helminthes persist for longer periods in the environment, but also because host immunity to helminthes is usually low to non-existent [18].

Several authors have used the two conventional techniques; sedimentation [14, 19, 20] and magnesium sulphate floatation [10] for the isolation of intestinal parasites from vegetables. From this study, sedimentation technique recovered more intestinal parasites from the vegetables than the floatation technique, hence this technique is recommended for use.

The results of this study have further emphasised the important role of raw or undercooked vegetables in the transmission of food-borne diseases caused by intestinal parasites. Vegetable farmers should therefore be enlightened on the modern use of night soil as fertilizer and the treatment of irrigation water or municipal waste water before use. There is however, need for the local council to put in place or improve the facilities in our markets and the need for the sanitary inspectors to be more proactive in their duties. Lastly, vegetable vendors should also be included in the screening of food handlers since most vegetables are ready-to-eat food items.

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