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PARASTITIC CONTAMINATION OF LEAFY VEGETABLES: A FUNCTION OF THE LEAF AREA INDEX (LAI)

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ABSTRACT

A survey was undertaken to determine the degree of contamination of some stable vegetables and their surrounding soils by parasites in Uyo, Nigeria. Out of the 780 leaves from six vegetables and 50 soil samples screened, 498 (63.9%) of vegetables and 36 (72%) of the soil samples were positive for parasite ova, larvae or cyst respectively. The prevalence of the parasites encountered from the vegetables and soil samples were *Ascaris lumbricoides* (76.3% vs 100%) Hookworm (63.9% vs 66.7%), *Trichuris trichiura* (53.8% vs 58.3%). *Strongyloides stercoralis* (14.1% vs 19.44%), *Gardia lamblia* (5.6% vs 25.0%), *Entamoeba histolytica* (2.0%). The results obtained indicate that Leaf Area Index (LAI) is a contributory factor to high prevalence of contamination irrespective of exposed surface area, the vegetables with smaller leaf are index value are more contaminated than vegetables with higher LAI value.

Keywords: Vegetables, Parasites, Soil, Contamination.

INTRODUCTION

In Nigeria and other developing countries of the world, intestinal parasites have been regarded as a major source of public health and socio-economic problems. The threat to lives by these parasites in this part of the world is enormous. Gastro-intestinal parasites have been implicated in medical complications such as occlusion of gut. anaemia, tozaemia and diarrhea (WHO, 1987). Reports by Okpala (1961), Nwosu (1981) and Asaolu *et al* (1992) have shown that intestinal parasitic infections are serious problems in most towns in Nigeria where the socio-economic situation and provision of basic amenities are at their lowest ebb. Edungbola and Obi (1992) stated that environmental conditions be it physical, biological or chemical, influence the development, growth manipulation, transmission and dissemination of intestinal parasites. Most parasitic worms, disseminate their ova or cyst in the faeces of their host thereby contaminating the surrounding soil, water and vegetables.

Although a lot of work has been done on parasites of vegetables, seeds, fruit and soil by Bhata *et al* (1978) Han (1978) Lin et al, 1980), Rude et al, (1984) Yadav and Tandon 1989), Umeche (1991) and Leon et al, 1992), there is still dearth of information on leafy vegetables that are commonly eaten raw on their assumed medicinal properties and are also used as garnishing in the preparation of other food in southern Nigeria. In view of the public health and socio-economic implication of intestinal parasites in Nigeria this study was undertaken to:

(a) Establish the presence of parasites on these commonly eaten vegetables.
(b) To determine the extent to which the leaf area index (height) of the vegetable plant contribute to the prevalence of the parasites on them.
(c) Finally, to add to the current base line data of the epidemiology of intestinal parasitic diseases in Nigeria.

MATERIALS AND METHODS

Study Area:

The study was carried out between January – October, 1999 in Uyo. Uyo is the capital town of Akwa Ibom State in Southern Nigeria. It is characterized by humid tropical climate, with annual rainfall reaching 3,000mm/annum. The area has a rather uniform temperature regime with annual value of 20.4°C – 35.7°C. There are poor sanitary and unhygienic conditions in most part of the town where open air defecation is a common

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practice. Water supply is a major problem to most of the inhabitants.

Ten vegetable gardens were randomly selected, most of the gardens were within the premises of the farmers who are mostly peasants. Soil samples were also taken from each of the gardens during the study.

Screening Techniques:

Six species of vegetables that are commonly eaten, used in garnishings and or in preparation of other foods were screened namely; *Talinum triangulare, Telferia occidentalis, Gnetum africanum, Solanum gilo, Vernonia amygdalina* and *Piper guineense*. These vegetables were collected directly from the gardens while some were purchased from public markets. The leaves of the vegetables were carefully detached from their stalk. Each leaf was washed separately and thoroughly with distilled water, which was subsequently concentrated by saturated salt flotation technique of Oyerinde (1978). The soil samples were also subjected to the salt flotation technique. A total of 780 leaves and 50 soil samples were examined for parasitic ova and or cyst. Diagnosis was based on identification of the characteristic helminth ova or protozoan cyst (WHO, 1980). The height, leaf length and leaf width were measured in centimeters. Leaf Area (LA) was determined according to the formula by Hoyt and Bradfield (1962) as follows: LA = L x W x 0.75 where L is the leaf length, W is the leaf width and 0.75 is a correction factor. Leaf Area Index (LAI) was determined for vegetables in the gardens only, using the formula by Boyd and Murray (1982).

$$LAI = \frac{\text{Leaf Area}}{\text{Ground Tissue (Height)}}$$

RESULTS

Of the 780 vegetable leaves screened, 420 were from the gardens while 360 came from public markets. Table 1 shows that 498 (63.8%) of the leaves were positive for one or more parasite eggs or cyst. *Talinum triangulare* 108 (83.1%) was the most contaminated followed by *Telferia occidentalis* 100 (76.9%), *Gnetum africanum* 86 (66.1%), *Solanum gilo* 81 (62.3%), *Vernonia amygdalina* 64 (49.2%) and *Piper guineense* 59 (45.4%). The result presented in Table 1 also show that vegetables from gardens 293 (69.8%) were more significantly contaminated than vegetables from public market ($P < 0.05$).

The Mean Leaf Area (MLA) and Leaf Area Index (LAI) of contamination of the vegetables are presented in Table 1. *Talinum triangulare* with MLA of 13.80cm² and LAI of 2.42 is the most contaminated of the vegetables. Thus the smaller the LAI value, the higher the degree of prevalence of contamination irrespective of MLA.

The prevalences of the parasite species encountered from 498 positive samples of vegetables and 36 positive samples of soil were *Ascaris lumbricoides* (76.3% vs 100%), Hookworm (63.9% vs 66.7%), *Trihuris trichiura* (53.8% vs 58.3%), *Strongyloides stercoralis* (14.1% vs 19.4%), *Gardia lamblia* (5.6% vs 25%), *Entamoeba histolytica* (2.0%) (Table 2).

DISCUSSION:

The results of the findings suggest that vegetables and soils are veritable sources of intestinal parasite among peoples exposed to them. Of all the vegetables screened *Talinum triangulare* had the highest degree of contamination followed by *Telfeira occidentalis, Gnetum africanum* (66.1%) and *Solanum gilo*. This result tallies with that of Paguio (1960) who worked on leafy vegetables like Lettuce, Parsley and Celery. Lin *et al* (1980), Leon *et al* (1992) have also obtained similar results from leafy vegetables. The high prevalence of contamination observed on these vegetables, might be connected with the fact, most of the farmers use human and animal faeces contaminated with parasites as manure. There is also the cultural belief that animal and human faeces are cheaper and better manure than artificial fertilizers hence, their preference. Rainfall could also be a major source of contamination as most of the vegetables were seen to be submerged under flood after heavy rainfall. There is the tendency that the flood must have carried with it, eggs and cyst of parasite from the surrounding environment since open air defecation is a common practice. This might have accounted for the high number of eggs recovered.

Paguio (1960) and Leon (1992) reported that vegetables with more exposed surface are more likely to be contaminated than the ones with small surface area. Results from the present study tend to disagree partially with such report because these findings have shown

TABLE 1: PREVALENCE AND INDEX OF CONTAMINATION WITH PARASITIC OVA AND OR CYSTS ON VEGETABLES

Vegetables	No Examined Garden (% positive) (a)	No Examined Market (% positive) (b)	Total No. Examined (%) Positive (c)	Mean Leaf Area (MLA) cm² (d)	Mean Ground Tissue cm (e)	Leaf Area Index (d/e)
talinum Triangulare (Water Leaf)	65/70 (92.8)	43/60 (71.7)	108/130 (83.1)	13.8 ± 1.57	5.7 ± 0.54	2.42
Telferia occidentalis (Fluted Pumpkin)	62/70 (88.5)	38/60 (63.3)	100/130 (76.9)	64.4 ± 9.10	22.3 ± 1.95	2.89
Gnetum africanum	51/70 (72.8)	35/60 (58.3)	86/130 (66.1)	24.6 ± 1.15	6.8 ± 0.30	3.61
Solanum gilo (Garden Egg Leaf)	46/70 (65.7)	35/60 (58.3)	81/130 (62.3)	68.2 ± 2.26	16.8 ± 0.57	4.05
Vernonia amygdalina (Bitter leaf)	36/70 (51.4)	28/60 (46.6)	64/130 (49.2)	10.2 ± 0.15	23.9 ± 0.51	4.27
Piper guineense	33/70 (47.1)	26/60 (43.3)	59/130 (45.4)	80.3 ± 0.15	9.7 ± 0.12	10.42
TOTAL	**293/420 (69.8)**	**205/360 (56.9)**	**498/980 (63.9)**			**27.66**

TABLE 2: FREQUENCY DISTRIBUTION OF PARASITE OVA, LARVAE AND CYSTS ISOLATED FROM POSITIVE VEGETABLES AND SOIL SAMPLES

Parasite	Vegetables (% Positive) n = 498	Soil Samples (% Positive) n = 36
Ascaris lumbricoides ova	**380 (76.3)**	**36 (100)**
Hookworm ova	**318 (63.9)**	**24 (66.7)**
Trichuris trichiura ova	**268 (53.8)**	**21 (58.3)**
Strongyloides stercoralis larvae	**70 (14.1)**	**7 (19.4)**
Gardia lamblia cysts	**28 (5.6)**	**9 (25.0)**
Entomoeba histolytica cysts	**10 (2.0)**	**0**
Taenia spp. ova	**0**	**3 (8.3)**

that *Vernonia amygdalina* and *Piper guineense* with MLA of 102cm² and 80.3cm² respectively were not as contaminated as *Talinum triangulare, Telfeira occidentalis, Gnetum africanum* and *Solanum gilo* with less leaf area values. I strongly believe that the shorter the height of vegetable plants above the ground, the more contaminated they are likely to be. Thus *T. triangulare, T. occidentalis, G. africanum* and *S. gilo* with LAI of 2.42, 2.89, 3.61, 4.05 (which is a function of height) were more contaminated than *V. amygdalina* and *P. guineense* with LAI value of 4.27 and 10.42 respectively. It stands to reason that any disturbance of the surrounding environment harbouring the parasite's eggs, by foraging animals, rainfall, wind and even human activities may lead to scattering and dispersing of these eggs or cysts. These eggs or cyst readily adhere to leaf surfaces of short vegetable plants. Suffice to mention that the broader the leaf and shorter the vegetable the more likely is the higher degree of contamination. This might have accounted for the high prevalence of contamination observed in lettuce and cabbage by other workers (Lin et al, 1989), Leon et al (1992). I did not work on lettuce and cabbage because it is not grown in Southern Nigeria.

On the frequency of the parasites encountered from the vegetables and soil, *Ascaris lumbricoides,* Hookworm, *Trichuris trichiura* were the most prevalent. Reports from the other developing countries and Nigeria, (Okpala, 1961; Rao,1979; Lin *et al*, 1980; Ejezie, 1981; Asaolu, 1992) show that *Ascaris,* Hookworm and *Trichuris* commonly called "unbiquitous triad" are most prevalent in human subjects. Suswan *et al* .(1992) and Asaolu (1992) attributed the high prevalance of the triad in Nigeria to ignorance, lack of good toilets and latrines, poor sanitation, poverty and inadequate health care system. Yadav and Tandon (1989), Umechi (1991) and Leon (1992) have obtained similar results in which *Ascaris,* Hookworm and *Trichuris* were most prevalent on the vegetables they investigated.

Even though a lot of work has been done on gastrointestinal parasites in Nigeria, there is dearth of statistical data on the public health and socio-economic implication of intestinal parasitic diseases. It is therefore imperative that appropriate preventive and control measures be introduced and adopted to alleviate the scourge of these infections among people. Therefore, farmers should be adequately instructed on the need to wash their vegetables before sending them to the market. The use of human and animals wastes as manure should be discouraged. The need for consumers to thoroughly wash their vegetables before eating them raw is therefore inevitable. Furthermore, the campaign by public health workers in Nigeria that vegetables to be consumed should not be properly boiled so as to retain their nutrients should be discontinued. The reason is that some of these parasitic ova and cysts may be resistant to low heat. Finally, the campaign for good hygiene should be stepped-up.

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