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Effects of Different Pretreatments on the Helminthological Qualities of Carrots (*Daucus Carota Subspecies Sativus*) Purchased from Different Markets in Akure, Nigeria

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Abstract:

*Carrots (*Daucus Carota Subspecies Sativus*) is a root-vegetable that is nutritious and one of the richest sources of beta carotene. The fact that it is a root vegetable makes it prone to helminth contaminations. Carrots can serve as vehicle of transmitting enteric parasitic pathogens throughout the process of planting to consumption. To control the rate of helminth infection through consumption of carrots (a – ready to eat vegetable), the effects of different pretreatments on the helminthological qualities of carrot was investigated. Fresh carrots were purchased from various markets located at different areas of Akure (Oja-Oba, Isinkan, FUTA gate and Shasha), Ondo State, Nigeria. Each sample was kept in different clean polythene bags and labeled appropriately according to the location of purchase and then taken to the Microbiology Research Laboratory at the Federal University of Technology, Akure, Nigeria (FUTA) for analyses. Fresh carrots were divided into 2; the 1st group was kept unwashed while the other group was washed with potable water and further subdivided into 5 groups. The first sub-group was left untreated, the second sub-group was soaked in brine (6%), the third sub-group in vinegar (5% acetic acid), fourth sub-group in sodium hypochlorite (0.05%), and the last sub-group was soaked in moringa seed aqueous extract (468mg per 250ml (w/v)). At different contact times (10minutes, 20minutes, and 30minutes), the helminthological assay was carried out to know the effects of these pretreatments on the helminthological load and types on the surface of carrots. Results from this study show that carrots bought from Shasha market had the highest helminthological contamination while carrots bought from Oja-Oba market and Isinkan market recorded the lowest. The various pretreatments used were able to remove the helminth's ova or larvae found on carrots even at 10 minutes contact time except those washed with potable water and brine. At ≥ 20 minutes contact time, no helminth was found on the carrots. From this finding, it can be concluded that carrots should be properly disinfected using any of the pretreatments mentioned above before consumption to prevent being infected with helminths.*

Keywords: Helminth, carrots, pretreatments, contact time

1. Introduction

Carrot is a root vegetable that is eaten raw. 'It is rich in beta carotene which is a powerful antioxidant which helps in maintaining a healthy skin and also keeps one away from many diseases. It is one of the ten most economically important vegetable crops in the world due to its nutritional value' (Mateljan, 2016). For a healthy diet people have been encouraged to eat lots of this vegetable 'however this vegetable can serve as vehicle of transmitting enteric parasitic pathogens from planting to consumption' (Adamu and Mohammed, 2012). This is because the application of night soil, animal manure and waste water as agricultural fertilizer which is being practiced in most developing countries serves as source of contamination of this vegetable. For example, the use of waste water for irrigation constitute greatly to parasitic contamination of carrots because this waste water according to Adeyanju and Olajumoke (2015) usually contains high numbers of eggs of human intestinal nematodes. According to Nampijja *et al.* (2012) 'the consumption of helminth infected vegetable by pregnant women can affect the development of cognitive function in infants.' Smith (2018) also reported that 'helminth infection can also lead to shortage of blood (anemia) because some of these helminthes reside in the blood stream without showing any symptoms.' Helminth infection is also known to cause malnutrition in children. It therefore becomes worthwhile to investigate how these parasitic pathogens can be eliminated from carrots prior to consumption. This study therefore was designed to investigate the effects of different pretreatments on the parasitological qualities of carrots.

2. Materials and Methods

2.1. Sample Collection

Fresh carrots were purchased from various markets located at different areas of Akure (Oja-oba, Isinkan, FUTA gate and Shasha). Each sample was kept in different clean polythene bags and labeled appropriately according to the place of purchase and then taken to the Microbiology Research laboratory FUTA for analyses.

2.2. Preparation of Different Solutions Used for the Soaking of Carrots

- Brine preparation: This was prepared according to Greger (2015)
- Sugar solution preparation: The method of Thompson (2018) was strictly followed.
- Vinegar: the vinegar used was a product of Food condiments Nigeria Limited, Ogun state. Composition: water, acetic acid, sodium chloride, 5% acetic acid by volume.
- Sodium hypochlorite: This was prepared according to the method of Rutola (1996).
- Moringa seed aqueous extract: this was prepared according to the method of Beth (2005) but with slight modification

2.3. Determination of the Helminthological Quality of Carrot after Exposure to Different Pretreatments

Fresh carrots sample purchased from different market locations were divided into 2; the 1st group was kept unwashed while the other group was washed with potable water and subdivided into 5 groups. The first sub-group was soaked in potable water, sub-second group was soaked in brine (6%), the third sub-group in vinegar (5% acetic acid), fourth sub-group in sodium hypochlorite (0.05%), and the last sub-group was soaked in moringa seed aqueous solution (468mg per 250ml (w/v)). At different contacts time (10 minutes, 20 minutes, and 30 minutes), the helminthological quality was determined using the method of Adeyanju and Olajumoke (2015). From each group, 200g of the scrapped surface of the carrots was soaked for in 1L physiological saline for 15 minutes. This was followed by vigorous shaking with the aid of mechanical shaker. The carrot sample was removed and the remaining solution was left for 10 hours to sediment. The top layer was discarded and the remaining washed solution was filtered through a sieve (425µm pore size) to remove large debris and the centrifuge at 2000rpm for 15 minutes. The supernatant was decanted into another tube which was examined by floatation and a few drops of the sediment were placed on glass slides, lugol's iodine was added and covered with cover slip and examined under microscope for larva of helminths using x10 and x40 objectives.

3. Results

Carrots bought from Shasha market that were not washed at all had the highest helminths contamination (3 ova of *Ascaris lumbricoides* and a larvae of hookworm), followed by carrots bought from FUTA area and not washed at all having 3 ova of *Ascaris lumbricoides*. Carrots bought from Isinkan and Oja-Oba markets had the least helminthic infection (Tables 1 and 2). The pretreatments used were able to totally remove ova and larvae of helminths from carrots at contact time of 10 minutes except those pretreated with brine that took 20 minutes contact time to totally remove ova or larva of helminth from the surface of the carrots used in this research work (Table 3).

Markets	Types of Parasite Isolated
Oja-Oba	A. lumbricoides
FUTA area	A. lumbricoides
Isinkan	A lumbricoides
Shasha	A. lumbricoides, Hookworm

Table 1: Types of Helminth Isolated From carrots Bought from Different Markets in Akure Prior Washing

Markets	Number of Ova or Larvae Isolated (ml/g)
Oja-Oba	1
FUTA area	3
Isinkan	1
Shasha	4

Table 2: Helminthological Load of Carrots Bought from Different Markets in Akure Prior Washing

Market/ Contact Time	Washed in Potable Water Only (ml/g)	Soaked in Brine (ml/g)	Soaked in Sodium Hypochlorite (ml/g)	Soaked in Vinegar (ml/g)	Soaked in Moringa Seed Aqueous Extract (ml/g)
10 minutes					
Oja-Oba	0	0	0	0	0
FUTA area	2	0	0	0	0
Isinkan	0	0	0	0	0
Shasha	1	1	0	0	0
20 minutes					
Oja-Oba	0	0	0	0	0
FUTA area	0	0	0	0	0
Isinkan	0	0	0	0	0
Shasha	0	0	0	0	0
30 minutes					
Oja-Oba	0	0	0	0	0
FUTA area	0	0	0	0	0
Isinkan	0	0	0	0	0
Shasha	0	0	0	0	0

Table 3: Effects of Contact Time on the Helminthological Quality of Carrot after Exposure to Different Pretreatments

4. Discussions

The different types of helminth found on unwashed carrot can be as a result of the fact that 'carrot is a root vegetable and therefore can easily be contaminated on the field during application of fertilizer, irrigation water, manure or faecal matter of wild animals' (Adeoye *et al.*, 2019). 'Handling, processing and method of storage can also contribute to the helminthological quality of carrots' (Kimberly, 2015). Ova of *Ascaris lumbricoides* and hookworm were isolated from carrots bought from Shasha market this was similar to the findings of Adamu and Muhammed (2012) that isolated similar helminthes from vegetables sold in Maiduguri, Nigeria. The hookworm isolated is an intestinal, blood-feeding parasitic roundworm that causes 'helminthiasis in people of all ages' (Adamu and Muhammed, 2012) likewise *Ascaris lumbricoides* infected person may suffer malnutrition. Therefore, parasitic infection is a serious issue that needs to be controlled to prevent health disaster. The findings from this study however showed that washing of carrots with any of the pretreatments used in this research can totally remove these helminthes. This agrees with the report of Avcioglu *et al* (2011) 'that proper washing and disinfecting raw vegetables can totally eliminate helminthes from vegetables.'

5. Conclusion

Washing of carrots in potable water and soaking in sterilant such as sodium hypochlorite, vinegar and moringa seed aqueous extract for ≤ 10 minutes totally eliminate all parasitic pathogens from carrots. However, in order to reduce the consumption of chemicals like vinegar and sodium hypochlorite 'which may have adverse effect due to overdose or long-time ingestion, for example, hypokalemia, osteoporosis or tooth decay' (Hill *et al.*, 2005), carrots pretreated with this chemical therefore should be rinsed again with potable water before consumption. However, to be on a safe side, moringa seed aqueous extract which is a natural product with no obvious side effect can be used instead since it has the potentials of eliminating helminthes on carrots ≤ 10 minutes as observed in this study.

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