

# Effects Of Moringa On The Surface Microbial Flora Of Carrots (*Daucus Carota L.*)

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**Abstract:** Carrot (*Daucus carota L.*) is one of the vegetables that can be eaten without cooking. This therefore makes it a very good medium for transfer of food borne pathogens such as *Escherichia coli*, *Staphylococcus aureus*, *Aspergillus flavus* and some other microorganisms if not properly washed before consumption. In this study, the effect of washing carrots with moringa seed aqueous extract alongside potable water on the surface of carrot was investigated using standard microbiological assays. Fresh carrots bought from different markets in Akure, Ondo State were grouped into 3. The 1<sup>st</sup> group was washed with potable water alone, the 2<sup>nd</sup> group with potable water and then with moringa seed aqueous extract while the last group was not washed at all. Moreover, the effect of soaking of carrots in moringa seed aqueous extract for different durations (10minutes, 20minutes and 30minutes) on the microbial types and load was also determined. The study showed that washing of carrots with moringa seed aqueous extract after the initial washing with potable water significantly ( $p < 0.05$ ) reduced the microbial loads and types from  $1.64 \times 10^6$  to  $1.1 \times 10^3$  CFU/ML and that the greatest reduction was observed after 30 minutes contact time. Moringa seed aqueous extract is therefore being recommended for washing of carrots in addition to normal washing with water to prevent consumption of microorganisms that can cause food borne illnesses.

**Keywords:** Fresh carrots, Food borne pathogens, Moringa seed aqueous extract.

## I. INTRODUCTION

Carrot (*Daucus carota*) is a vegetable that is consumed in its raw state. Therefore, it is classified as ready to eat (RTE) vegetable. These RTE vegetable however could serve as vehicle of food borne illnesses because of the pathogens that may form part of their microflora, thereby causing serious health problems. It therefore becomes imperative to make sure that carrots are hygienically safe for consumption.

Although carrots are normally washed with water before eating, water will only remove the dirt and a small percentage of the microorganisms on its surface especially those associated with the dirt. Moreover, although, there are also food disinfectants or sterilants like vinegar that can be used to

reduce or completely remove microbes from ready to eat vegetables, its use is discouraged because too much of it can cause hypocalcaemia (Hill *et al.*, 2005). Moreover, it is expensive and not readily available in rural communities, therefore, there is the need to search for alternatives that are: natural, cheap, readily available and have no side effects.

*Moringa oleifera* (family Moringaceae) is a plant with known antibacterial activity (Priadarshini *et al.*, 2013). It becomes worthwhile to investigate whether it can be exploited for surface sterilising of carrots before consumption as an alternative to chemical sterilants like vinegar that may constitute health hazard when consumed in high dose.

## II. MATERIALS AND METHODS

### SAMPLE COLLECTION

Fresh carrots were purchased from various markets located at different areas of Akure, Ondo State (Oja-oba, Isinkan, FUTA area 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.

### PREPARATION OF MORINGA SEED AQUEOUS EXTRACT

This was prepared according to the method of Beth (2005).

### DETERMINATION OF THE MICROBIAL QUALITIES OF CARROT AFTER EXPOSURE TO MORINGA SEED AQUEOUS EXTRACT

Fresh carrots bought from different markets in Akure were grouped into 3 groups. The 1<sup>st</sup> group was washed with potable water alone, the 2<sup>nd</sup> group with potable water and then with moringa seed aqueous extract while the last group was not washed at all. The effect of soaking of carrots in moringa seed aqueous extract for different durations (10minutes, 20minutes and 30minutes) on the microbial types and load was also determined. The microbial types and loads were evaluated using standard microbiological methods to know the effect of the pretreatments on the microbial quality.

### ISOLATION AND IDENTIFICATION OF MICROORGANISMS PRESENT ON THE SURFACE OF CARROT

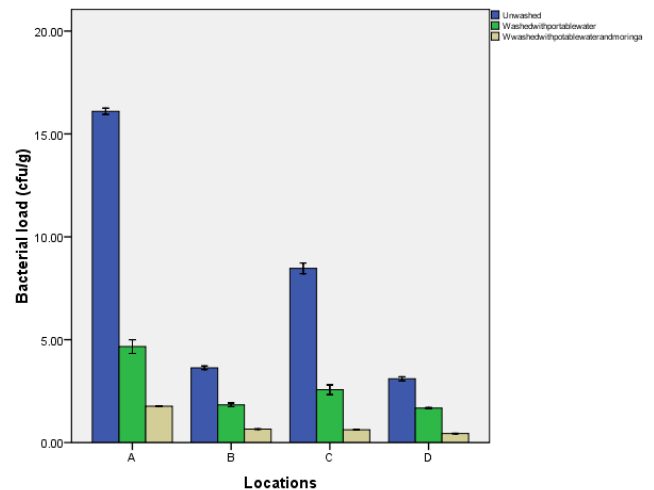
All the microbiological analyses were carried out using standard microbiological methods. Bacterial isolated were identified according to Holt *et al.* (1994) while the fungi isolated were identified according to Samson *et al.* (2010).

## III. RESULTS

### EFFECTS OF MORINGA SEED AQUEOUS EXTRACT ON THE MICROBIAL LOAD ON THE SURFACE OF CARROTS PURCHASED FROM DIFFERENT MARKETS IN AKURE

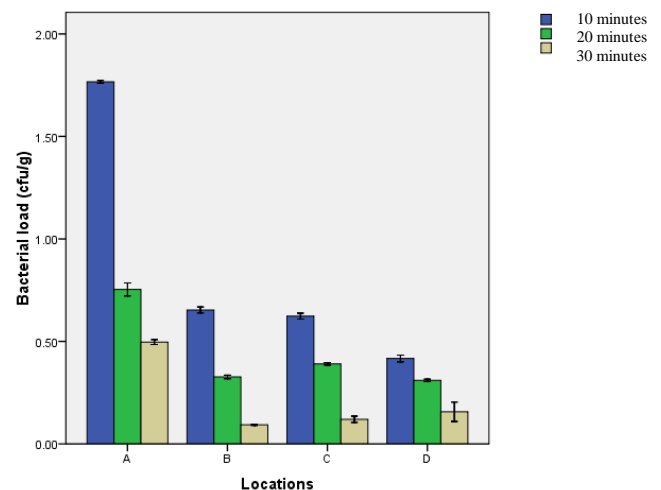
The moringa seed aqueous extract used to wash carrots exerted varying degrees of growth inhibitory effect on the bacterial and fungal loads of the carrots bought from the selected markets that were used in this investigation. Carrots washed with either water or moringa seed aqueous extract showed a great reduction in the bacterial population as compared with the unwashed carrots (fig. 1). While greater reduction was observed in soaked in moringa seed aqueous extract at different time intervals of (10 minutes, 20 minutes and 30 minutes) respectively, with those subjected to 30

minutes contact time having the lowest bacterial counts (Fig 2).



KEY: A = Oja-Oba market  
B = FUTA area  
C = Shasha market  
D = Isinkan market

Figure 1: Effects Of Moringa Aqueous Extract On The Bacterial Load ( $\times 10^5$ ) On The Surface Of Carrots Purchased From Selected Markets In Akure Ondo State, Nigeria



KEY: A = Oja-Oba market  
B = FUTA area  
C = Shasha market  
D = Isinkan market

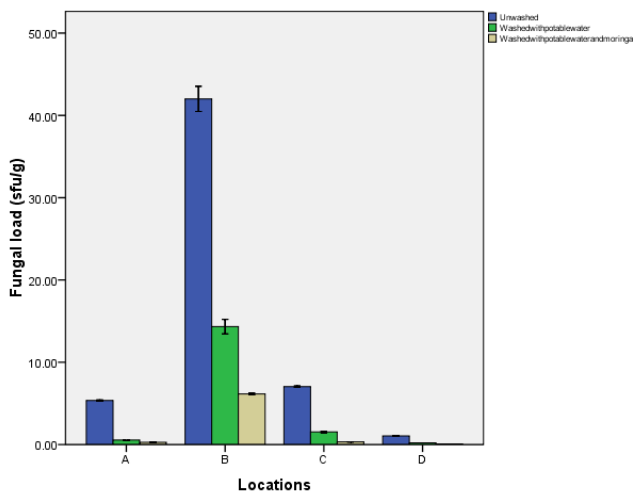
Figure 2: Effects Of Contact Time With Moringa Aqueous Extract On The Bacterial Load ( $\times 10^5$ ) On The Surface Of Carrots Purchased In Selected Markets In Akure, Ondo State, Nigeria

### EFFECTS OF MORINGA SEED AQUEOUS EXTRACT ON THE FUNGAL LOAD ON THE SURFACE OF CARROTS BOUGHT FROM DIFFERENT MARKETS IN AKURE, ONDO STATE

Carrots washed with either water or the moringa seed aqueous extract showed a great reduction in the fungal

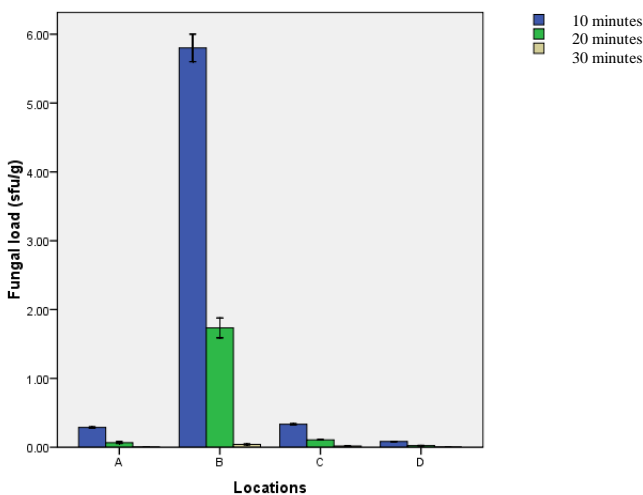
population as compared with the unwashed carrots (Fig 3). The greatest reduction in fungal counts was observed after 30 minutes of soaking the carrots in the aqueous extract (Fig 4).

**EFFECTS OF MORINGA SEED AQUEOUS EXTRACT ON THE MICROBIAL TYPES ON THE SURFACE OF CARROTS BOUGHT FROM DIFFERENT MARKETS IN AKURE, ONDO STATE:** A total number of 7 bacterial species were isolated from carrots purchased at Oja-Oba market that were not washed at all (*Klebsiella ozaenae*, *Micrococcus luteus*, *Staphylococcus epidermidis*, *Enterobacter aerogenes*, *Escherichia coli*, *Bacillus pasteurii*, *Citrobacter freudii*) while four fungi; (*Mucor mucedo*, *Sacharomyces cerevisiae*, *Peacilomyces viriotii*, *Aspergillus flavus*) were isolated. Moringa seed aqueous extract was able to inhibit the growth of these organisms except *B. pasteurii* after 30 minutes contact time of carrots with the aqueous extract (Table 1). Similar trends were also observed in Tables 2-4.



KEY: A = Oja-Oba market  
B = FUTA area  
C = Shasha market  
D = Isinkan market

Figure 3: Effects Of Moringa Aqueous Extract On The Fungal Load ( $X10^2$ ) On The Surface Of Carrots Purchased From Selected Markets In Akure, Ondo State, Nigeria



KEY: A = Oja-Oba market

B = FUTA area  
C = Shasha market  
D = Isinkan market

Figure 4: Effects Of Contact Time With Moringa Aqueous Extract On The Fungal Load ( $X10^2$ ) On The Surface Of Carrots Purchased In Selected Markets In Akure, Ondo State, Nigeria

TYPES OF MICROORGANISMS (BACTERIA/FUNGI)	UNWASHED (CONTROL)	WASHED WITH POTABLE WATER	WASHED WITH POTABLE WATER AND MORINGA AQUEOUS EXTRACT
BACTERIA	<i>Klebsiella ozaenae</i> , <i>Micrococcus luteus</i> , <i>Staphylococcus epidermidis</i> , <i>Enterobacter aerogenes</i> , <i>Escherichia coli</i> , <i>Bacillus pasteurii</i> , <i>Citrobacter freudii</i> .	<i>Staphylococcus epidermidis</i> , <i>Micrococcus luteus</i> , <i>Enterobacter aerogenes</i> , <i>Bacillus pasteurii</i> , <i>Citrobacter freudii</i> .	<i>Bacillus pasteurii</i>
FUNGI	<i>Mucor mucedo</i> , <i>Sacharomyces cerevisiae</i> , <i>Peacilomyces viriotii</i> , <i>Aspergillus flavus</i> .	<i>Sacharomyces cerevisiae</i> , <i>Peacilomyces viriotii</i> , <i>Mucor mucedo</i> .	Nil

Table 1: Effects of moringa on the microbial types on the surface of carrots purchased from Oja-Oba market at 30 minutes contact time

TYPES OF MICROORGANISMS (BACTERIA/FUNGI)	UNWASHED (CONTROL)	WASHED WITH POTABLE WATER	WASHED WITH POTABLE WATER AND MORINGA AQUEOUS EXTRACT (468G/250ML)
BACTERIA	<i>Klebsiella ozaenae</i> , <i>Micro-coccus luteus</i> , <i>Staphylococcus aureus</i> , <i>Enterobacter aerogenes</i> , <i>Staphylococcus epidermidis</i> , <i>Escherichia coli</i> .	<i>Staphylococcus aureus</i> , <i>Streptobacillus moniliformis</i> , <i>Staphylococcus epidermidis</i> .	<i>Staphylococcus aureus</i>
FUNGI	<i>Mucor mucedo</i> , <i>Sacharomyces cerevisiae</i> , <i>Rhizopus megricans</i>	<i>Mucor mucedo</i> , <i>Sacharomyces cerevisiae</i> , <i>Rhizopus megricans</i>	<i>Sachraromyces cerevisiae</i> .

Table 2: Effects of moringa on the microbial types on the surface of carrots purchased from FUTA area at 30 minutes contact time

TYPES OF MICROORGANISMS (BACTERIA/FUNGI)	UNWASHED (CONTROL)	WASHED WITH POTABLE WATER	WASHED WITH POTABLE WATER AND MORINGA AQUEOUS EXTRACT (468G/250ML)
BACTERIA	<i>Bacillus subtilis</i> , <i>Bacillus cereus</i> , <i>Staphylococcus epidermidis</i> , <i>Aerobacter aerogenes</i> , <i>Micrococcus luteus</i> .	<i>Proteus mirabilis</i> , <i>Aerobacter aerogenes</i> <i>Bacillus subtilis</i> .	<i>Staphylococcus aureus</i> , <i>Aerobacter aerogenes</i>
FUNGI	<i>Sacharomyces cerevisiae</i> , <i>Peacilomyces viriotii</i> , <i>Penicillium italicum</i> .	<i>Sacharomyces cerevisiae</i> , <i>Peacilomyces sp</i> ,	Nil

Table 3: Effects of moringa on the microbial types on the surface of carrots purchased from Shasha market at 30 minutes contact time

TYPES OF MICROORGANISMS (BACTERIA/FUNGI)	UNWASHED (CONTROL)	WASHED WITH POTABLE WATER	WASHED WITH POTABLE WATER AND MORINGA AQUEOUS EXTRACT (468G/250ML)
BACTERIA	<i>Micrococcus luteus</i> , <i>Staphylococcus aureus</i> , <i>Proteus mirabilis</i> , <i>Staphylococcus epidermidis</i> , <i>Bacillus subtilis</i> .	<i>Staphylococcus aureus</i> , <i>Proteus mirabilis</i> , <i>Staphylococcus epidermidis</i> .	<i>Bacillus subtilis</i> .
FUNGI	<i>Sacharomyces cerevisiae</i> , <i>Aspergillus nidulans</i> , <i>Pleurothecium recurvatum</i> .	<i>Aspergillus nidulans</i> , <i>Pleurothecium recurvatum</i> .	Nil

Table 4: Effects of moringa on the microbial types on the surface of carrots purchased from Isinkan market at 30 minutes contact time

#### IV. DISCUSSION

In this study, the effect of moringa seed aqueous extract on the microflora of carrot was investigated. The high microbial load 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 (Jorge *et al.*, 2015). Carrots can also become carrier of different bacterial species and or their toxins due to processing

and storing errors (Kimberly, 2015). The High fungal load on carrots purchased in FUTA area can be as a result of nearness to the main road where dust is raised from time to time by moving vehicles. Some of the microorganisms isolated in this investigation (*Staphylococcus aureus*, *Escherichia coli*, *Aspergillus flavus*) are known to be pathogenic. For example, *E. coli* is known to cause gastroenteritis, a food borne infection (Madappa, 2016). *S. aureus* can cause significant food-borne illness (Ahmad, 2016) while *A. flavus* can also lead to food poisoning (Machida and Gomi, 2010). Although washing with potable water was observed to remove some of these microorganisms, however washing with moringa seed aqueous extract not only appreciably reduced bacterial load, it completely removed all moulds present on the carrots. The reduction of the bacterial load mediated by moringa seed aqueous extract agrees with the findings of Priadarshini *et al.* (2013) who worked on petroleum ether leaf extract of *Moringa oleifera* which showed maximum inhibition on the growth of *E. coli*, *B. subtilis*, *P. aeruginosa* and *Proteus vulgaris*.

#### V. CONCLUSION

This study has been able to show that moringa seed aqueous extract greatly reduced the bacterial loads and totally eliminated mould count of carrots. It is therefore suggested that moringa seed aqueous extract should be used to wash carrot and a contact time of 30 minutes should be allowed before consumption for best result. Further research work is recommended in order to identify and isolate the bioactive principle present in the seeds of moringa responsible for its antimicrobial properties.

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