JOSTIR Publication 2025 | ISSN: 1118-3896

Special Issue December 2025 | 408-412

Journal of Science, Technology and Innovation Research
Volume 1 Special Issue | December 2025

Fungal Pathogens Responsible for Diseases in Carrot (*Daucus carota* L.) Production in Ondo State Nigeria

Adeoye, O. O.

Department of Science Laboratory Technology, University of Medical Sciences, Ondo city, Nigeria.

Correspondence: ooadeoye@unimed.edu.ng

ABSTRACT

Carrot (*Daucus carota* L.) is a vegetable that is mostly eaten raw without cooking. As a result, it can serve as a vehicle for fungi to move from farm to stomach, while these microflora also contribute to carrot spoilage and postharvest losses. This study, investigated fungi responsible diseases and spoilage of carrots. Carrots were purchased from local farmers in Akure, Ondo State, Nigeria, labeled appropriately and taken to the laboratory for analysis. The carrots were divided into 2 groups (A and B). Group A was further subdivided and stored under refrigeration (4 ± 2 ºC) and colanders (30 ± 2 ºC) to study fungi associated with spoilage, while group B was used to determine fungi present on fresh carrot surfaces. Eight fungi were isolated from carrot surfaces obtained from four markets (*Sacharomyces cerevisiae*, *Aspergillus nidulas*, *Pleurothecium recurvatum, Mucus mucedo, Penicillium italicum, Peacilomyces viriotie, Aspergillus niger* and *Rhizopus nigricans*). From spoilt carrots, *Sclerotini sclerotiorum*, *Penicillium natatum*, *Aspergillus niger, Aspergillus flavus, Mucur mucedo* and *Rhizopus nigricans* were isolated. All these spoilage organisms were implicated in carrot spoilage except *A. flavus*. Some of the fungi isolated (*A. niger and A. flavus*) are pathogenic and capable of producing toxic metabolites posing potential health risks to consumers. In addition, *Sclerotini sclerotiorum* causes devastating economic losses to farmers. Identifying and controlling fungal diseases of carrot is essential for reducing postharvest losses, ensuring food safety, and maintaining the availability of high-quality, nutritious vegetables.

Keywords: Food-borne diseases, food spoilage, microflora, carrots, fungi

Introduction

Carrot (*Daucus carota* subsp. *sativus*) is a root vegetable, typically orange in colour, though varies including purple, black, red, white, and yellow cultivars exist, all of which are domesticated forms of the wild carrot, *Daucus carota*, native to Europe and Southwestern Asia (Singn *et al.*, 2021). The plant probably originated in Iran and was originally cultivated for its leaves and seeds. The characteristic orange colour is from beta-carotene, making carrots a rich source of vitamin A. It is associated with heart and eye health, improved digestion, and even weight loss (Singn *et al.,* 2021). Carrots are a nutrient-dense root vegetable with a variety of health benefits. Besides beta-carotene, carrots contain lutein, zeaxanthin, and other phytonutrients that protect cells from oxidative stress. Despite their sweet taste, carrots have a low glycemic index, so they do not spike blood sugar significantly (Silva-Dias, 2014). All these qualities make carrot an important vegetable. Unfortunately, carrots are highly perishable because of its high moisture content and loads of microorganisms on its

doi.org/10.51459/jostir.2025.1.Special-Issue.0232

surface being a root vegetable (Motegoonkar *et al*. (2024)), making it difficult to keep for a longer period. Fungi are eukaryotic, non-vascular, non-motile and heterotrophic organisms, it may be unicellular or filamentous that includes microorganisms such as yeasts, molds and mushrooms. Most fungi are decomposers; they feed on organic matter and cause various degree of spoilage of farm produce. Some of these fungi are also pathogenic attacking both animal and plant. In plants, fungi can destroy plant tissue directly or through the production of potent toxins, which usually ends in host death (Samanta, 2015). Fungi are significant pathogens of carrots, causing a variety of diseases that can lead to severe pre- and post-harvest losses. The major fungi diseases affecting carrots are *Sclerotinia sclerotiorum* causing watery soft rot, *Rhizopus stolonifer* responsible for soft rot, *Fusarium spp.* cause dry rot, Penicillium spp. causes blue or green mold, Alternaria spp. causes black rot or black spot on carrots.

Due to high load of fungi on carrot surface being a root vegetable coupled with high moisture content, farmers face a lot of problem in storing carrot. Carrot farmers, especially in developing regions, often face several storage-related problems that affect both quality and profitability. Carrots require cool (0 – 4^{o}C) and humid (90 – 95%) conditions (Motegoonkar *et al*., 2024), which are difficult to maintain without infrastructure and many smallholder farmers lack access to refrigerated storage, leading to rapid spoilage due to inadequate storage, carrots often rot or shrink within days, resulting in significant losses. It becomes worthwhile to investigate the pathogenic fungi associated with carrots in order to prevent spoilage and provide a basis for future control measures.

Materials and Methods

Sample Collection

Carrots

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. From each bag carrots were taken for further experiments.

Isolation and Identification of fungi present on fresh carrots bought from different markets

The microorganisms present on the surface of carrots bought from the various markets were isolated by scraping the surface of the carrot with sterile knife on sterile aluminum foil. One gram of the scrapped carrot surface was weighed aseptically into universal bottle, separate bottle for different sample and diluted serially to dilution 10^{-3}. From the 10^{-2} and 10^{-3} dilution tubes, 1ml was taken and pipetted into sterile petri dishes respectively in triplicates to culture fungi. Sterile molten agars at 45^{o}C (saboraud agar (SA) and potato dextrose agar (PDA)) were used and were incubated at 28^{o}C for 72 hours. After incubation, the colonies were counted and isolated colonies were streaked onto a new plate SA and PDA and incubated at appropriate temperatures to obtain a pure culture. The isolates were identified according to Samson *et al.* (2010); Akshata *et al*. (2025). This was done for all the carrots bought at different markets respectively.
The morphology of the pure fungus on plate was observed for its shape, colour (front and reverse)**.** The microscope studies of the pure fungi isolated were done by mounting a bit of each colony into a drop of distilled water on a glass slide. It was then thinned out with a pin, stained with methylene blue to view the hyphal structures and lactophenol cotton blue was used for the observation of septate or non-septate hypha under the microscope using x10 and x40 objectives.

Isolation and Identification of Microorganisms on Spoilt Carrot during Storage at 4 ± 2^{o}C

Carrots bought from different markets in Ondo State were stored at 4 ± 2^{o}C and 27 ± 2^{o}C respectively and were monitored for signs of spoilage. The fungi isolated were identified according to Samson *et al.* (2010).

Pathogenicity Test on Fungi Isolated from Spoilt

Carrots during Storage

Microorganisms isolated from spoilt carrot were further subjected to test to determine the actual microorganisms responsible for the spoilage using a modified method of Kahala *et al.* (2012). Fresh wholesome carrots were washed with potable water, sterilized with vinegar (60% concentration) for 30 minutes then rinsed with sterile distilled water and allowed to dry. These were grouped into eight (2 carrots per group). Each group was inoculated with different microorganisms isolated from spoilt carrot and packed in sterile aluminum foil and sterile food bags respectively and stored at 30 ± 2°C. The infected carrots were observed daily for signs of spoilage.

Result and Discussion

Result

Fungi Present on the Surface of Fresh Carrots

Eight fungi *Mucor mucedo, Aspergillus nidulans, Sacharomyces cerevisiae, Penicillium italicum, Peacilomyces viriotii, Aspergillus flavus, Rhizopus nigricans and Pleurothecium recurvatum* were isolated (Table 1). The most frequently encountered microorganisms was *Saccharomyces cerevisiae* (100%), it was isolated from all the carrots bought at different markets.

Fungi Isolated from Spoilt Carrots during Storage at 4 ± 2 °C and 30 ± 2 °C

Fungi isolated from spoilt carrots stored at 30 ± 2°C are *Aspergillus niger, Aspergillus flavus*, *Sclerotinia sclerotiorum, Penicillium notatum, Rhizopus nigricans* and *Mucur Mucedo* and only four fungi were isolate from carrots kept at 4 ± 2°C as shown in Table 2.

Pathogenicity of Fungi Isolated from Spoilt Carrots during Storage

Five out of the six fungi isolated from spoilt carrots; *S. sclerotiorum, P. notatum, R. nigricans* and *Mucur Mucedo, A. niger* were found responsible for spoilage of carrots in the spoilage test as shown in Table 3 below.

Discussion

This study investigated the impact of fungi isolated from carrots on carrot spoilage and associated health

Table 1. Frequency of occurrence of types of fungi on the surface of carrots bought from different markets in Akure.

Types of Microorganisms	Frequency of occurrence (%)					
	A	B	C	D	Total	Percentage
Mucor mucedo	+	+	-	-	2	50
Aspergillus nidulans	-	-	-	+	1	25
Saccharomyces cerevisiae	+	+	+	+	4	100
Penicillium italicum	-	-	+	-	1	25
Peacilomyces viriotii	+	-	+	-	2	50
Aspergillus flavus	+	-	-	-	1	25
Rhizopus nigrican	-	+	-	-	1	25
Pleurothecium recurvatum	-	-	-	+	1	25

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

Table 2. Fungi Isolated from Spoilt Carrots during Storage at 4 ± 2°C and 30 ± 2°C

	Storage Temperature	
Isolates	**4 ± 2°C**	**30 ± 2°C**
Aspergillus niger	-	+
Aspergillus flavus	-	+
Sclerotinia sclerotiorum	-	+
Penicillium notatum	+	+
Rhizopus nigricans	+	+
Mucur Mucedo	+	+

Table 3. Pathogenicity of Fungi Isolated from Spoilt Carrots during Storage

Fungi isolated from spoilt carrot	Fungi responsible for spoilage
Aspergillus niger	✓
Aspergillus flavus	*
Sclerotinia sclerotiorum	✓
Penicillium notatum	✓
Rhizopus nigricans	✓
Mucur Mucedo	✓

Keys: √ - Responsible * - Not responsible

risks. Some of fungi isolated from carrots are known to contribute to post-harvest spoilage supporting the findings of Yao *et al*. (2025) and may pose health risks due to the production of mycotoxins or other harmful metabolites. Out of the eight fungi isolated from carrots bought from different markets in Ondo State, Nigeria, one was found to be pathogenic (*A. flavus*). *Aspergillus flavus* is known to produce afflatoxin (Fakruddin *et al*., 2015) which can cause food intoxication. Some other organisms isolated; *S. sclerotiorum*, *P. notatum, R. nigricans, Mucur Mucedo,* and *A. niger* were responsible for spoilage of carrots. Farmers experience great losses after harvest as a result of these fungi found on carrots. Some of these fungi contaminate carrots right from field and during transportation (Alegbeleye *et al*., 2018). Carrots stored at low temperature were spoilt by fewer fungi and no pathogenic fungus was isolated, this explained why low storage temperatures help in food preservation and reduced cases of foodborne illnesses caused by pathogenic fungi, although some of these fungi were still able to grow at 4°C (Goswami *et al*., 2019).

Identifying and characterizing fungal pathogens affecting carrots provides essential information for designing targeted control measures, including appropriate use, cultural practices, and integrated disease management approaches, thereby reducing unnecessary chemical applications.

Conclusion

Fungal pathogens play a significant role in limiting carrot production by causing a wide range of diseases that affect plant growth, yield and root quality both

in field and during storage. This study highlights the importance of identifying the major fungal species responsible for carrot diseases and spoilage. The presence of these pathogens not only reduces economic returns for farmers but also threatens food quality and availability.

Farmers are advised to prevent or control fungi contamination right from the field. As carrots are root vegetables, they are particularly susceptible to contamination by spoilage organisms present in soil. Therefore, farmers are encouraged to implement crop rotation to reduce soil-borne fungal pathogen, use seeds that are resistant to diseases and irrigate their farms using clean water.

References

Akshata, M., Bharose, A. A., Yogira, M., Dhawale, R. N. and Dudhare, M. S. (2025). Isolation and Identification of Endophytic Fungi Associated with Roots of Soybean Plant and Their Antagonist Activity against Fusarium spp. *Journal of Advances in Biology and Biotecnology*, 28(8): 619 - 628

Alegbeleye, O. O., Singleton, I., and Sant'Ana, A. S. (2018). Source and Contamination Routes of Microbial Pathogens to Fresh Produce during Field Cultivation: A Review, *Food Microbiol*, 73: 177 – 208. doi: 10.1016/j.fm.2018.01003

Goswami, M., Pathak, V., Bharti, S. K., Chappalwar, A. M., Ojha, S. Singh, S.,and Singh, S (2019). Effect of Low Temperature Preservation on Quality Characteristics of Meat, *Journal of Animal Feed Science and Technology*, 7(1): 1 - 6

Kahala, M., Blasco L., Joutsjoki V. (2012). Molecular Characterization of Spoilage Bacteria as a Means to Observe the Microbiological Quality of Carrot. *Journal of Food Protection*, 75(3): 523 – 532.

Kheyrodin, H. (2011). Crop Rotation for Managing Soil-Borne Plant Diseases. *African Journal of Food Science and Technology*, 2(1): 001 - 009

Mategoon, S., Shankar, A., Tazeen, H., Gunjal, M., Payyanad, S. (2024). A Comprehensive Review on Carrot (*Daucus carota* L.): The Effect of Different Drying Methods on Nutritional Properties and its Processing as Value-added Foods. *Science Direct* 2(3): 667 – 688

Samanta, I. (2015). General Characteristics of Fungi. In: Veterinary Mycology. *Springer*, pp 3 -8. https://doi.org/10.1007/978-81-322-2280-4_2

Samson, R.A., Houboaken, J., Thrane, U., Frisrad, J.C. and Andersen, B. (2010). Food and Indoor Fungi. Laboratory Manual Series. Utrecht, The Nertherland: CBS-KNAW Fungal Biodiversity center. DTU System Biology. Pp 106 – 352.

Silva-Dias, J. (2014). Nutritional and Health Benefits of Carrots and Their Seed Extracts, *Food and Nutrition Sciences*, 5(22):2147 – 2156. doi: 10.4236/fns.2014.522227.

Singn, M. N., Srivastava, R., and Yadav, I. (2021). Study of Different Varietis of Carrot and its benefits for Human Health: AReview, *Journal of Pharmacology and Phytochemistry*, 10(1): 1293 – 1299. Doi: 10.22271/phyto.2021.v10.i1r.13529

Yao, K. O., Kouame, A. E. P. and Silue, N. S. (2025). Fungi Responsible for Storage Rot of Carrot (*Daucus carota* L.). *International Journal of Plant & Soil Science*, 37(5); 503 - 508