Survey of the Fungi that Infect Imported Carrot (*Daucus Carota L.*) in the Areas of Baghdad

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Abstract
An extensive survey of fungi associated with post-harvest *Carrot daucus* Carota L. degradation in different parts of the Baghdad market. Samples were collected from three different regions of Adhamiya, Kadhimiya and Sadiyah. Five fungal species, such as, *Aspergillus niger*, *Alternaria radicina*, *Sclerotinia sclerotiorum*, *Geotrichum candidum* and *Rhizoctonia carotae*, which isolated from the decayed samples. In this context, *Alternaria radicina* showed the highest Frequency percentage about 23.3%. Both *Sclerotinia sclerotiorum*, *Aspergillus niger*, *Geotrichum candidum* at 20% and *Rhizoctonia carotae* showed the lower frequency at 16.7%. Pathogenic test showed that all isolated fungi were pathogenic to host roots Storage. However, *Aspergillus niger* was found to be more pathogenic to carrots resulting in a rapid disintegration of infected roots by 90% during the incubation period. While *Alternaria radicina*, *Sclerotinia sclerotiorum*, was 80% followed by *Geotrichum candidum* 75% and *Rhizoctonia carotae* less than 70%.

Keywords: Post-harvest fungi, Carrot, Chloramphenicol, pathogenicity, storage.

Introduction
Fruits and vegetables are of great commercial and nutritional importance. So that Play a necessary role in human nutrition by providing some fundamental materials like minerals and Vitamins, also essential in a human diet daily, that ability to help save healthy vegetables well consumed on large scale. The most important factors that adversely affect the economic value of fruit and vegetables is the low shelf life. Leading to many problems, Most notably the pathogen activity[1]. Vegetables and Fruits are exposed to microbial infection by connect with soil, water and dust and through working at harvest or during the postharvest process. That makes them carry a large domain of microorganisms included human and plant pathogens[2]. *Carrot* (*Daucus Carota L.*) is the important crops refer to Umbelliferae family. Carrot roots Use for the first period for medical purpose then gradually use it as food of the total 39 vegetables and Fruits place carrots rank 10 in nutrition value[3]. Carrots are a perfect source of nutritional fiber and whit mineral molybdenum and are rarely found in many vegetables. beneficial in the...
metabolism of carbohydrates and fats also important for iron absorption. It is a good source of manganese and magnesium which needed for bone and protein, creating new cells, activating vitamin B, nerves, ergonomic muscles, blood clotting, energy production[4] high percentage of carrot fruits are lost annually due post-harvest degradation Caused by fungal pathogens[5]. The possibility of transmission of field fungus to the store through the contamination of containers with spores resulted in the spread of a large number of fungi and the result of mismanagement after the harvesting process in terms of transport, storage and marketing[6]. The first report of fungi pathogens that affect the carrot due to poor storage conditions were Botrytis cinerea causes Gray Rot[7]. Chalara elegans causes black root rot[8]. Geotrichum candidum causes Sour rot[9]. Sclerotinia sclerotiorum causes cottony soft rot[10]. Rhizoctonia carotae causes crater rot[11]. Alternaria radicina causes black rot[12].

The current study highlights fungi associated with carrot rot storage in Baghdad, the current study highlights fungus associated with carrot rot storage in Baghdad, and isolate and identify post-harvest fungi that caused decay of carrot rot.

Methods and Materials

Samples Collection

Carrot samples collected from Three markets in the city of Baghdad, Adhamiya, Kadhimia and Sadiyah which were surveyed. The samples were collected in sterilized plastic containers then transfer to the laboratory.

Isolation and Identification

The sample first surface sterilized by washing under runner faucet water to remove dirt such as the sand. cut infected parts and take samples with dimensions (0.5 cm) sterilized surface with 1% sodium hypochlorite solution for 1 minute and then wash with distilled water three times leave until drying, (0.5 cm) distributed on Petri dishes containing Potato Dextrose Agar (PDP) supplemented with Chloramphenicol 250 mg / L. Three pieces were put in the dish with three replicates and incubated at 27 °C±2 for 7 days. A short part of mycelium from each fungus colony was transferred aseptically unto fresh plate containing the medium used. The fungi were purified by repeated sub-culturing and repeated several times until pure fungi were isolated. Using sterile inoculating needle, minute part of each isolate was taken and mix at the center of a clean microscopic slides containing drop of Lactophenol cotton blue stain, enveloped with cover slips and observed under the microscope. Identification was made with reference to standard textbooks such as[13][14]. The fungal frequency was calculated according the following equation:

\[
\text{Percentage of species frequency} = \frac{\text{colonies number of species}}{\text{total number of species colonies}} \times 10
\]

Pathogenicity test

Fresh and healthy was washed from the carrot with tap water and the sterilized superficially with 0.1% sodium hypochlorite solution 2-3 Minutes. Then wash carrot with water until the odor disappears, and the cylindrical cores of the tubers are removed in diameter 5mm by cork borer. Different fungal isolates were inserted into puncture and closed with paraffin wax to prevent spores from spreading out. Control was used without fungal isolates Figure 1, Treatment tubers were placed separately in sterile polythene bags and incubated at 27 ± 2 °C for 20 days. Samples are examined from time to time and the appearance of rot is observed until the end of the incubation time[15].

Figure 1: (a) Make a gap (b) place the isolates inside with cover by wax.
Results and Discussion

Isolation and Identification

The results of isolation and identification, as shown in Table 1, 30 isolates of fungi, divided into 5 fungal species, the most common species frequency were Alternaria radicina Figure 2, which was present in all three Regions with a frequency of 23.3%, followed by Sclerotinia sclerotiorum Figure 3, which showed Sour rot, Aspergillus niger Figure 4 which showed black rot, Geotrichum candidum with a frequency 20% For each of them, and then Rhizoctonia carotae which showed crater rot and frequency 16.7%. These results largely coincide with the results of researchers interested in isolating fungi from the carrot in India[15], in Nigeria[16], in turkey[11], in Saudi Arabia[8] find that Aspergillus niger occurred most frequently. This results agreed also with the findings of[17] who reported that the species of Rhizopus and Aspergillus occurred mostly frequently of total isolates.

Table 1: Fungus frequency of Carrots collected from three locations in Baghdad

| Fungus | Regions or areas | Frequency % |
|--------|-----------------|-------------|
|        | Adhamiya        | Kadhimiya   | Sadeya | Total |
| Geotrichum candidum | 3 | 1 | 2 | 6 | 20 |
| Rhizoctonia carotae | 1 | 1 | 3 | 5 | 16.7 |
| Aspergillus niger | 2 | 2 | 2 | 6 | 20 |
| Sclerotinia sclerotiorum | 1 | 2 | 3 | 6 | 20 |
| Alternaria radicina | 3 | 2 | 2 | 7 | 23.3 |
| **Total** | **10** | **8** | **12** | **30** | **100** |

Pathogenicity test

All the isolate was pathogenic on carrot roots. The percentage of pathogenicity ranged from 70 % to 90 % Table 2. Among all pathogenic fungal, Aspergillus niger was found to be relatively very virulent Figure 5 followed by Alternaria radicina, Sclerotinia sclerotiorum, Geotrichum candidum, and Rhizoctonia carotae. The inoculated pathogens on pathogenicity test cause the rotting of special host roots. Their percentage of roting was 90 %, 85 %, 80 %, 75% and 70 % respectively.
This result corresponds to its conclusion [15] regarding the most pathogenic isolation.

![Image](image.png)

**Figure 5:** *Aspergillus niger* after incubation period 20 days.

**Table 2:** Pathogenicity of the isolates on carrot and radish roots

| Fung             | Percentage of rotting in carrot % |
|------------------|-----------------------------------|
| *Aspergillus niger* | 90                                |
| *Alternaria radicina* | 80                                |
| *Sclerotinia sclerotiorum* | 80                                |
| *Geotrichum candidum* | 75                                |
| *Rhizoctonia carotae* | 70                                |
| Control          | Zero                              |

**Conclusion**

In this study revealed that five types of fungi were found to cause carrot rot during the period of storage or transport operations and marketing in the areas of the city of Baghdad. These pathogens lead to tremendous loss not only in terms of quantity but also reduce their economical and nutritional value. Some of these fungi are able to produce mycotoxins that pose a danger to the health of consumers. Urgent attention must be given to this situation, thereby increasing the economic yield of the product. This will ensure a significant contribution to the crop in food supply and the national economy.

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