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Research Article

# Evaluation of the Effectiveness of Turmeric and Ginger in Inhibiting the Growth of the Fungus, *Aspergillus niger*, the Causal Agent of Black Mold Disease of Onion

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ABSTRACT

Black mold, predominantly caused by *Aspergillus niger*, is a major postharvest constraint affecting onion bulb quality and storage life. The increasing need for safer alternatives to conventional fungicides has stimulated interest in plant-derived antifungal treatments. This study investigated the fungal etiology of black mold in onion bulbs and evaluated the efficacy of turmeric and ginger powders and extracts against *A. niger* under laboratory and storage conditions. Among the fungi isolated from diseased bulbs, *A. niger* was predominant (80.0%), followed by *Penicillium* spp. (13.3%) and *Botrytis* spp. (6.6%). All 12 *A. niger* isolates exhibited pathogenicity, with disease severity ranging from low to 80.0%; isolate No. 2 was the most virulent. *In vitro* assays demonstrated concentration-dependent antifungal activity of both botanical treatments. At 3%, turmeric and ginger powders produced the highest growth inhibition (79.1%), while their extracts achieved 75.0% inhibition, compared with no inhibition in the untreated control. Under storage conditions, all treatments markedly suppressed disease development relative to the untreated control, which recorded 95.48% disease severity. Ginger powder provided the greatest protection, reducing disease severity to 22.30%, followed by turmeric extract (22.90%) and turmeric powder (32.70%). These findings highlight the strong antifungal potential of readily available turmeric and ginger preparations, particularly ginger powder, for suppressing *A. niger* and extending the storage quality of onion bulbs. Their practical potential warrants further validation under commercial storage conditions, including optimization of dosage, application method, and treatment timing.

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## Introduction

Onion (*Allium cepa* L.) is one of the most significant vegetable crops globally, with widespread cultivation in Arab nations such as Algeria, Egypt, Iraq, Jordan, Saudi Arabia, and Syria. It is one of the most important vegetable crops, second to tomato in several crop production systems. Onion is a member of the Amaryllidaceae family and is distinguished by a bulb consisting of thickened, fleshy leaf bases that form around a short stem, and serve mainly as storage organs. The root system is fibrous and a floral scape grows at the end of the vegetatively growing period and ends in a spherical inflorescence with many small white, star-shaped flowers. The typical pungent smell of onion is mainly due to sulfur compounds, which are also responsible for the known antimicrobial activities of onion (Griffiths et al., 2002).

Onion is vulnerable to many fungal and other diseases that can result in significant losses in the field and during post-harvest handling, storage and marketing. Black mold, blue mold and neck rot are among the important post-harvest diseases (Raju and Naik, 2007; Kareem et al., 2020; Jamel et al., 2025). Of these diseases, black mold of stored onion bulbs is one of the most economically significant and is mostly caused by *Aspergillus niger*. The pathogen can infect the bulb prior to harvest, or enter through wounds and damaged tissues during harvest and handling where disease usually increases in severity during storage. Environmental conditions, especially temperature and relative humidity, significantly affect the incidence and severity of black mold. *A. niger* grows best at temperatures of around 30-35°C whereas high relative humidity of more than 80% promotes the growth of fungi, colonization of tissues and subsequently deterioration of bulbs. Infection can be undetected between the scales of the bulb, but when environmental conditions become favorable for pathogen growth, visible symptoms appear and eventually lead to extensive decay and deterioration of stored bulbs (Maude et al., 1984; El Nagerabi and Ahmed, 2003; Gupta et al., 2012).

However, recently, sustainable and eco-friendly methods to control plant pathogens and boost host resistance to bacterial, fungal, nematode, and viral diseases have been emphasized (Adhab, 2021; Hussein et al., 2024; Adhab et al., 2025). Plant based products, such as botanical extracts and powders, being a source of bioactive compounds with potential antifungal and antimicrobial properties have been receiving a lot of attention. For instance, alcoholic extracts of garlic and ginger have been found to have significant antifungal activities against *Aspergillus flavus*, *A. niger* and *Cladosporium herbarum* and the inhibitory activity of the ginger extract was found to be higher than the garlic extract against the tested fungi (Tagoe et al., 2009). Likewise, extract of turmeric (*Curcuma longa*) has shown significant antifungal activity against *A. niger* with complete (100%) inhibition of the fungal growth during experimental conditions (Pawar et al., 2014).

The encouraging results obtained from the plant materials, however, require further evaluation under controlled, laboratory and practical storage conditions to establish the efficacy of plant materials and their ability to minimize onion post-harvest losses caused by *A. niger*. Hence, the present study was targeted to assess the antifungal activity of turmeric and ginger against *A. niger*; the causal agent of black mold of onion in laboratory and storage conditions in powder and extract formulations.

## Materials and Methods

### Isolation and identification of fungal pathogens

Samples of onion bulbs showing typical signs of infection such as discoloration, tissue damage and rotting were taken from several markets of Baghdad, Iraq, including Abu Ghraib, Al-Alawi, Al-Dora, and Al-Khadra district. The samples were brought to the laboratory, carefully cleaned with tap water and cut into pieces of about 0.5-1.0 cm. The pieces were surface-sterilized for 3 min in 2% sodium hypochlorite, rinsed with sterile distilled water to eliminate traces of disinfectant and dried on sterile filter paper.

Sterilized pieces of tissue were transferred to potato dextrose agar (PDA) in 9-cm-diameter Petri dishes. The medium was autoclaved for 30 min at 121°C and 1.5 kg $cm^{-2}$ pressure. For inhibition of bacterial growth, amoxicillin was added to the medium. The plates were inoculated with three pieces of tissue and incubated for 3 days at 25 ± 1°C. Morphological characteristics of emerging fungal colonies were studied and a small sample of the growing colony margin was transferred with a sterile needle onto fresh PDA for purifying single isolates. The cultures were incubated for 5 days at 25± 1°C. The frequency equation was used to determine the frequency of isolation for fungi.

$$\text{Frequency of the fungus (\%)} = \frac{\text{Number of pieces in which the fungus appeared in the dishes}}{\text{Total number of pieces}} \times 100$$

### Pathogenicity test of fungal isolates

Healthy onion bulbs obtained from local markets were surface-sterilized with 1% sodium hypochlorite, rinsed thoroughly with sterile distilled water, and allowed to dry under aseptic conditions. The bulbs were placed individually in sterile plastic boxes. A 5-mm-diameter mycelial disc was cut from the actively growing margin of each fungal isolate using a sterile cork borer and introduced into a prepared wound on the bulb. Each isolate was tested using three replicates, and a total of 12 fungal isolates were evaluated. The inoculated bulbs were incubated at 25 ± 1°C. Disease severity was assessed according to the disease index described by McKinney (1923), using the following rating scale:

0 = No visible damage
1 = 1–10% damaged tissue
2 = 11–20% damaged tissue
3 = 26–50% damaged tissue
4 = 51–75% damaged tissue
5 = >75% damaged tissue

The disease severity index was calculated using the corresponding disease-index equation.

$$\text{Infection severity} = \frac{(\text{Number of plants in grade } 1 \times 1 + \ldots\ldots + \text{Number of plants in grade } 5 \times 5)}{\text{Total number of plants} \times \text{highest grade}} \times 100$$

***In vitro* evaluation of turmeric and ginger against *A. niger***

Turmeric rhizomes (*Curcuma longa* L.) and ginger rhizomes (*Zingiber officinale* Roscoe) were purchased from local markets of Baghdad, Iraq. Their botanical identities were confirmed by the Herbarium of the University of Baghdad. The rhizomes were dried and finely ground using an electric blender.

For ethanolic extraction, 100 g of each powdered material was transferred separately into a 250 mL glass flask, and 200 mL of 90% ethanol was added at a 1:2 (w/v) ratio. The mixtures were agitated on an electric shaker for 24 h to facilitate extraction of bioactive compounds. The extracts were filtered through Whatman No. 2 filter paper using a Büchner funnel. The filtrates were concentrated in a water bath at 40°C to obtain crude viscous extracts. The mass of the dried crude extract was recorded, and extraction yield was calculated as follows:

$$\text{Extraction yield (\%)} = \frac{\text{Mass of dried crude extract}}{\text{Mass of starting powder}} \times 100$$

PDA was prepared and sterilized before incorporation of turmeric and ginger powders at concentrations of 1, 2, and 3% (w/v). Ethanolic extracts of turmeric and ginger were incorporated into PDA at the same concentrations. The media were continuously mixed to ensure uniform distribution of the powders and extracts and were subsequently poured into 9-cm-diameter Petri dishes and allowed to solidify.

A 5-mm-diameter mycelial disc of *A. niger* was placed centrally on each plate using a sterile cork borer. The plates were incubated for 5 days at 25 ± 1°C or until fungal growth in the untreated control reached the edge of the plate. Fungal growth was assessed by measuring two perpendicular colony diameters, and the mean diameter was used for subsequent analysis. The percentage inhibition of mycelial growth was calculated using the standard inhibition formula.

$$\text{Inhibition (\%)} = \frac{\text{Mean diameter of control} - \text{Mean diameter of treatment}}{\text{Mean diameter of control}} \times 100$$

***In vivo* evaluation of turmeric and ginger powder and their extracts against *A. niger* using onion bulbs under storage conditions**

Fresh and healthy onion bulbs were procured from local markets and surface sterilized using sodium hypochlorite (1%). After surface-sterilization, onion bulbs were thoroughly washed with sterile distilled water and dried. Turmeric and ginger powder and their extracts were applied separately to the bulbs at 3% concentration. The treated bulbs were then transferred to sterile plastic boxes and were inoculated with a 5 mm diameter mycelial disc of the most pathogenic isolate of *A. niger*. A sterile cork borer was used to make a wound in each bulb and insert the disc.

There were three biological replicates for each treatment. Pathogenic control consisted of inoculated but untreated bulbs. The bulbs were kept for 14 days at 25°C and then the disease severity was evaluated according to the McKinney disease rating scale (1923) as described above. The disease severity was determined according to the disease-index equation of the respective disease as mentioned above.

**Storage conditions and statistical analysis**

Onion bulbs were stored for 21 days in dark conditions at 30°C and 70% relative humidity (RH) for evaluation of storage assay. The experimental design used was completely randomized design (CRD) in which the treatment was fixed effect and replicates were experimental units. Each treatment had three biological replicates. The experiment was replicated two times independently and the two sets of data were combined following the confirmation of no significant run × treatment interaction.

Analysis of variance (ANOVA) was used to analyze data and Fisher's least significant difference (LSD) test at $\alpha = 0.05$ was applied to separate treatment means. The SPSS software was used for all statistical analyses. The Shapiro–Wilk and Levene's tests were used respectively to test the assumption of normality and homogeneity of variance.

## Results and Discussion

### Isolation and diagnosis

Isolation of fungi from infected onion bulbs revealed that *A. niger* was the predominant species, accounting for 80.0% of the isolates (Table 1, Figure 1). *Penicillium* spp. represented 13.3%, whereas *Botrytis* spp. accounted for 6.6%. The predominance of *A. niger* is consistent with previous reports identifying this fungus as an important pathogen of onion bulbs. The pathogen may infect bulbs before harvest and subsequently develop during storage, where favorable environmental conditions can promote disease development (Alam et al., 2002; Zait and Abu AlFeith, 2021).

Table 1. Fungi isolated from onion bulbs.

| No | Fungi | Frequency (%) | Number of isolates |
|---|---|---|---|
| 1 | *A. niger* | 80 | 12 |
| 2 | *Penicillium* spp. | 13.3 | 2 |
| 3 | *Botrytis* spp. | 6.6 | 1 |

### Pathogenicity test of *A. niger* isolates

All the tested 12 isolates of *A. niger* were found pathogenic to onion bulbs with varying degrees of severities (Table 2). Disease severity of each isolate was significantly higher than the uninoculated control (Figure 2). Of all the isolates, isolate No. 2 was found to be the most virulent with 80.0% disease severity followed by isolate No. 1 which showed disease severity of 70.0%. On the other hand, isolate No. 4 was the least severe of all the isolates tested. The present findings are in agreement with previous studies, which reported the involvement of *A. niger* in the development of black mold on onion bulbs and validated its pathogenicity. Infection can cause softening and breakdown of tissues, partly by the production of hydrolytic enzymes which break down components of the plant cell-wall. The ability of some *Aspergillus* species to produce aflatoxins also highlights its significance in stored onion bulbs (Alam et al., 2002; Prajapati and Patil, 2015).

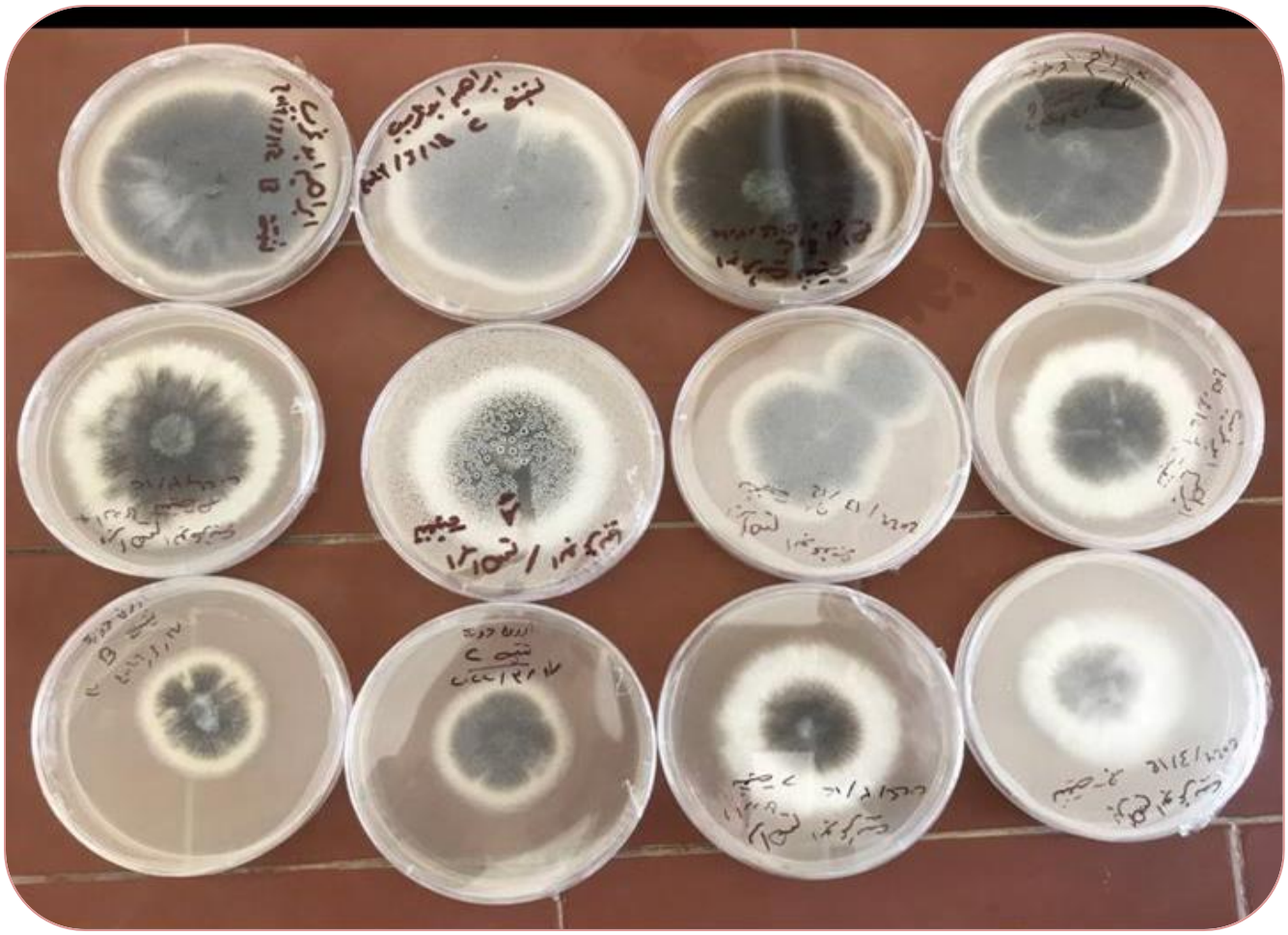

Figure 1. Fungal isolates recovered from infected onion bulbs.

Figure 2. Pathogenicity of isolates of *A. niger* on onion bulbs.

Table 2. Pathogenicity of isolates of *A. niger* on onion bulbs.

| No. | Treatments | Infection severity (%)* |
|---|---|---|
| 1 | Control | 0 |
| 2 | Isolate 1 | 70 |
| 3 | Isolate 2 | 80 |
| 4 | Isolate 3 | 35 |
| 5 | Isolate 4 | 20 |
| 6 | Isolate 5 | 45 |
| 7 | Isolate 6 | 55 |
| 8 | Isolate 7 | 20 |
| 9 | Isolate 8 | 22 |
| 10 | Isolate 9 | 35 |
| 11 | Isolate 10 | 45 |
| 12 | Isolate 12 | 22 |
| | LSD 0.05 (%) | 1.613 |

* Each value is the mean of three replicates.

**Effectiveness of turmeric and ginger powders and extracts against *A. niger* under laboratory conditions**

Table 3 and 4 showed that both turmeric and ginger treatments suppressed the growth of *A. niger*, which depended on the treatment and concentration. The highest inhibition of 79.1% was caused by the 3% concentration of both turmeric and ginger powders. Likewise, the corresponding extracts at 3% inhibited growth by 75.0% while the control did not show any inhibition.

The fungicidal properties of turmeric and ginger might be due to various bioactive compounds found in them. These antagonistic plants are rich in a wide array of bioactive compounds such as alkaloids, phenolics, and other secondary metabolites which possess antimicrobial activities against a number of pathogens. These compounds can disrupt key cellular functions and inhibit the growth of pathogenic fungi. For instance, alkaloids have been found to influence nucleic acid-related processes and thus prevent the growth and development of fungi (Rostamzad et al., 2019; Barbara and Kristjan, 2021).

Table 3. Effect of turmeric and ginger powder on growth inhibition of *A. niger* under laboratory conditions.

| Concentration (%) | Mean colony diameter (cm) | % Inhibition |
|---|---|---|
| 1% turmeric | 3.00 | 50.0 |
| 2% turmeric | 1.75 | 70.8 |
| 3% turmeric | 1.25 | 79.1 |
| 1% ginger | 3.00 | 50.0 |
| 2% ginger | 1.500 | 75.0 |
| 3% ginger | 1.25 | 79.1 |
| Control | 9.00 | 0.0 |
| LSD | 1.09 | 1.92 |

* Each value is the mean of three replicates.

Table 4. Effect of turmeric and ginger extract on growth inhibition of A. niger under laboratory conditions.

| Concentration (%) | Mean colony diameter (cm) | % Inhibition |
|---|---|---|
| 1% turmeric | 2.00 | 50.0 |
| 2% turmeric | 2.50 | 58.3 |
| 3% turmeric | 1.50 | 75.0 |
| 1% ginger | 2.00 | 66.6 |
| 2% ginger | 2.00 | 66.6 |
| 3% ginger | 1.50 | 75.4 |
| Control | 9.00 | 0.0 |
| LSD | 1.30 | 5.01 |

* Each value is the mean of three replicates.

**Effectiveness of turmeric and ginger powders and extracts against *A. niger* under storage conditions**

All the turmeric and ginger treatments tested in this study decreased disease severity under storage conditions as compared to untreated control (Table 5). Ginger powder showed the lowest disease severity of only 22.30% followed very closely by turmeric extract which gave disease severity of 22.90%. In contrast, disease severity was 95.48% in the control treatment. The disease severity was also significantly reduced by turmeric powder giving disease severity of 32.70%.

Table 5. Effect of turmeric and ginger powder and extract on disease severity of *A. niger* under storage conditions.

| Concentration 3% | Disease severity (%) |
|---|---|
| Turmeric powder | 32.70** |
| Turmeric extract | 22.90 |
| Ginger powder | 22.30 |
| Ginger extract | 47.33** |
| Control | 95.48 |
| LSD 5% | 2.09 |

** indicates significance at $P \leq 0.01$.

Ginger contains a number of phenolic compounds, such as gingerols and shogaols, which might be responsible for the strong antifungal activity of ginger. These compounds can cause disruption of essential metabolic processes, inhibition of spore germination and affect the integrity of fungal membranes and thus restrict the growth of fungi (Melvin et al., 2009; Rostamzad et al., 2019; Bayas-Morejón et al., 2020; Obaid et al., 2022).

Similarly, turmeric's fungicidal properties are also attributed to its bioactive compounds, specifically curcumin, which is regarded as one of the main constituents that contribute to the biological activities of turmeric. Antifungal activities of turmeric might also be ascribed to other compounds such as cineole, flavonoids, saponins, sesquiterpenes, and zingiberene, which disrupt cell membranes and other cellular processes in fungi (Chattopadhyay et al., 2004; Perumal et al., 2004).

**Conclusion**

The study clearly showed that *Aspergillus niger* was found to be the predominant fungus involved in black mold of onion bulbs. All the tested isolates of *A. niger* were pathogenic, with isolate No. 2 being the most virulent. The antifungal activities of turmeric and ginger powders and extracts were found to be significant against *A. niger* in the laboratory as well as in storage. At laboratory conditions, the highest inhibition was observed with 3% concentration while ginger powder gave the best results under storage conditions on the basis of disease severity. Based on these results, turmeric and ginger based preparations showed promise as alternate means of inhibiting growth and development of black mold in stored onion bulbs with ginger powder being the most promising. Additional investigations are recommended to confirm the effectiveness and appropriate application rates and treatment schedules of these formulations under commercial storage conditions and in field environment.

**Authors' Contributions**

DSJ designed the experiment, conducted the field investigations, and carried out the experimental work, providing critical guidance on the experimental design. FAA provided overall supervision, ensured analytical consistency throughout the study, contributed to data interpretation, and supported research refinement at various stages of the project. TAF prepared the initial manuscript draft, including structuring the content, compiling the results, and integrating preliminary interpretations. Subsequently, all authors critically reviewed and revised the manuscript, contributed to its intellectual refinement, cross-checked the data and analyses, and approved the final version of the manuscript.

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**Conflict of Interest**

The authors declare no conflict of interest.

**Sustainable Development Goals Targeted**

SDG 2: Zero Hunger
SDG 3: Good Health and Well-being
SDG 12: Responsible Consumption and Production

**Policy Addressed**

The findings support the use of turmeric and ginger as potential plant-based alternatives for sustainable management of *Aspergillus niger* in stored onions. Their application could reduce dependence on synthetic fungicides, improve food safety, extend storage life, and minimize postharvest losses, contributing to sustainable crop protection and food security.

**References**

Adhab, M., 2021. Be smart to survive: virus-host relationships in nature. Journal of Microbiology, Biotechnology and Food Sciences 10, e3422-e3422.

Adhab, M., Ezzulddin, D.L., Ahmed, A.S., 2025. Cultivating resilience: Sustainable plant virus control in Iraq's agricultural landscape. BIO Web of Conferences 192, 06002.

Alam, S., Akhter, N., Begum, F., Banu, M.S., Islam, M.R., Chowdhury, A.N., Alam, M.S., 2002. Antifungal activities (*in vitro*) of some plant extracts and smoke on four fungal pathogens of different hosts. Pakistan Journal of Biological Sciences 5, 307-309.

Barbara, S., Kristjan, P., 2021. Photofungizides based on curcumin and derivates thereof against *Candida albicans* and *Aspergillus niger*. Antibiotics 10(11), 1315.

Bayas-Morejón, F., Ramón, R., García-Pazmiño, M., Mite-Cárdenas, G., 2020. Antibacterial and antioxidant effect of natural extracts from *Baccharis latifolia* (chilca). Caspian Journal of Environmental Sciences 18, 489-493.

Chattopadhyay, I., Biswas, K., Bandyopadhyay, U., Banerjee, R.K., 2004. Turmeric and curcumin: Biological actions and medicinal applications. Current Science 87, 44-53.

El-Nagerabi, S.A.F., Ahmed, A.H.M., 2003. Storability of onion bulbs contaminated by *Aspergillus niger* mold. Phytoparasitica 31, 515-523.

Griffiths, G., Trueman, L., Crowther, T., Thomas, B., Smith, B., 2002. Onions-a global benefit to health. Phytotherapy Research 16, 603-615.

Gupta, R., Khokhar, M.K., Lal, R., 2012. Management of the black mold disease of onion. Journal of Plant Pathology and Microbiology 3, Article 133.

Hussein, H., Al-Dulaimi, S., Adhab, M., 2024. Ecofriendly method to control fusarium wilt on tomato. In: Innovation and Technological Advances for Sustainability, pp. 135-141. CRC Press.

Jamel, D.S., Malik, S.T.A., Hassan, A.K., Ayesh, A.A., 2025. Biological functions of garlic (*Allium sativum* L.) and its active compounds against pathogens. University of Baghdad, College of Agricultural Engineering Sciences.

Kareem, T.A., Hassan, A.K., Naemah, R.A., Alsamir, M., 2020. Morphological and molecular characteristics of fungal isolates causing onion neck rot disease. Biochemical and Cellular Archives 20(1), 403-408.

Maude, R.B., Taylor, J.D., Munasinghe, H.L., Bambridge, J.M., Spencer, A., 1984. Storage rots of onions. National Vegetable Research Station Annual Report, 64-66.

McKinney, H.H., 1923. A new system of grading plant diseases. Journal of Agricultural Research 26, 195-218.

Melvin Joe, M., Jayachitra, J., Vijayapriya, M., 2009. Antimicrobial activity of some common spices against certain human pathogens. Journal of Medicinal Plants Research 3, 1134-1136.

Obaid, R.F., Kadhim Hindi, N.K., Kadhum, S.A., Jafar Alwaeli, L.A., Jalil, A.T., 2022. Antibacterial activity, anti-adherence and anti-biofilm activities of plants extracts against *Aggregatibacter actinomycetemcomitans*: An *in vitro* study in Hilla City, Iraq. Caspian Journal of Environmental Sciences 20, 367-372.

Pawar, P.B., Solaskar, M.T., Patil, V., Jadhao, K.R., 2014. *In vitro* antifungal activity of selected plant extracts against a spoilage fungus *Aspergillus niger* of onion (*Allium cepa* L.). The Ecoscan, Special Issue 5, 1-4.

Perumal, G., Subramanyam, C., Natarajan, D., Srinivasan, K., Mohanasundari, C., Prabakar, K., 2004. Antifungal activities of traditional medicinal plant extracts: A preliminary survey. Journal of Phytological Research 17, 81-83.

Prajapati, B.K., Patil, R.K., 2015. Black mold rot: An important post-harvest disease of onion and its management. Popular Kheti 3, 162-163.

Raju, K., Naik, M.K., 2007. Survey and assessment for the

post-harvest diseases of onion in north-eastern Karnataka. Karnataka Journal of Agricultural Sciences 20, 164-165.

Rostamzad, H., Abbasi Mesrdashti, R., Akbari Nargesi, E., Fakouri, Z., 2019. Shelf life of refrigerated silver carp, *Hypophthalmichthys molitrix*, fillets treated with chitosan film and coating incorporated with ginger extract. Caspian Journal of Environmental Sciences 17, 143-153.

Tagoe, D.N.A., Baidoo, S.E., Dadzie, I., Kangah, V.G., Nyarko, H.D., 2009. A comparison of the antimicrobial (antifungal) properties of garlic, ginger and lime on *Aspergillus flavus*, *Aspergillus niger*, and *Cladosporium herbarium* using organic and water base extraction methods. The Internet Journal of Tropical Medicine 7, 44-50.

Zait, A.Q., Abu Al Feith, S.M., 2021. Antagonistic efficacy of some plant extracts against *Aspergillus niger* isolated from *Allium cepa* L. Al-Bayan Scientific Journal 9, 531-540.