ZIBELINE INTERNATIONAL™ PUBLISHING

Acta Scientifica Malaysia (ASM)

DOI: http://doi.org/10.26480/asm.02.2024.57.60

ISSN: 2521-5051 (Print)
ISSN: 2521-506X (Online)
CODEN: ASMCCQ

RESEARCH ARTICLE

THE INVESTIGATION OF MICROORGANISMS IN FRESH VEGETABLES: BACTERIA AND FUNGI

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ARTICLE DETAILS

Article History:

Received 23 May 2024
Revised 08 June 2024
Accepted 24 July 2024
Available online 26 July 2024

ABSTRACT

The purpose of this study was to separate microorganisms (fungi and bacteria) from three distinct vegetables: celery, lettuce, and arugula. The Potato Dextrose Agar (PDA) method of the power plate method was utilized to isolate and identify various fungal species, and the same procedure was followed to isolate bacteria from the samples under study. The findings identify the fungi and display the total number of colony forming units (CFU) in three different vegetables grown on PDA medium. Rhizopus sp., Aspergillus sp., Alternaria, yeast, Penicillium, Alternaria, and Rhodotorula were the most often isolated fungi. Mucor and Demaceous were the less common species of fungi found. The first grocery store had celery with a higher count of bacteria—268 CFU. With 250 CFU, lettuce had the highest amount of bacteria in the second grocery. Additionally, celery was found to have a higher concentration of bacteria in the third grocery store—280 CFU.

KEYWORDS

Food-borne illness, fungus species, and vegetables

1. INTRODUCTION

Because they offer so many additional nutritional benefits, vegetables continue to be one of the most crucial parts of a balanced diet. According to vegetables are abundant dietary sources of micronutrients, minerals, vitamins, and, most importantly, fiber and antioxidants (Eni et al., 2010). These nutrients are essential for maintaining human health and wellness as well as preventing disease.

Due in large part to their convenience, freshness, flavor, and health advantages, fresh vegetables are becoming more and more popular as people become more conscious of the importance of eating healthily (Olaimat and Holley, 2012). Because they offer so many additional nutritional benefits, vegetables continue to be one of the most crucial parts of a balanced diet. The analysis vegetables are abundant dietary sources of micronutrients, minerals, vitamins, and, most importantly, fiber and antioxidants (Eni et al., 2010). These nutrients are essential for maintaining human health and wellness as well as preventing disease.

Due in large part to their convenience, freshness, flavor, and health advantages, fresh vegetables are becoming more and more popular as people become more conscious of the importance of eating healthily (Olaimat and Holley, 2012). According to some studies conducted in Ghana, vegetables sold at grocery stores may be contaminated with microorganisms, primarily bacteria (Amoah, 2014).

The kingdom Myceteae includes fungi. This group's unique traits include being eukaryotic, not photosynthetic, lacking tissue differentiation, having a chitin or other polysaccharide-based cell wall, and spreading through spores that can be either sexual or asexual (Benson, 2002).

Vegetable contamination may be caused by a number of factors. Bacterial contaminants can be introduced to vegetables during pre- and post-harvest handling. In many developing nations, using inadequately treated wastewater for irrigation increases the risk of contaminating vegetables grown with irrigation. The roles of increasing the application of improperly composted manures to soil and contaminating it with animal wastes are comparable (Erkan et al., 2008).

It is crucial to assess the microbiological quality of fresh, leafy salad vegetables that are typically eaten raw rather than cooked. Thus, the goal of the current study was to look into the microbiological contaminations of celery, lettuce, and arugula.

2. MATERIAL AND METHOD

2.1 Sampling

The samples were collected from three distinct locations within specific grocery stores. They were then cultured using the power plate method on PDA media and incubated for three to five days at 25°C for the study of fungal growth, and for 24 hours at 37°C for the study of bacteria.

During the study period, nearby farmlands provided high-quality fresh samples of the vegetable under investigation, this is commonly consumed. Using random sampling techniques, a sample of vegetables from farms was chosen. After being meticulously gathered by hand and placed into polyethylene bags, the examined leafy vegetables were promptly brought back to the laboratory. polyethylene bags, and as quickly as possible returned to the laboratory.

Potato Dextrose Agar (PDA) is the medium that is used to isolate and identify fungi (Onuorah, 1982).

2.2 Chemical compound Quantity

Dextrose……20 g.

Potato……..200 g.

Agar……..20 g.

Distill water (D.W.)……1 L

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Cite The Article: Rezan Sabah Ahmed, Tablo Abdulrahim Ahmed (2024). The Investigation of Microorganisms in Fresh Vegetables: Bacteria and Fungi. *Acta Scientifica Malaysia, 8(2): 57-60.*

2.3 Identification Of The Fungal Genera

For purification and identification, the fungal isolates were moved to sterile plates. The cultivated fungi were placed onto a slide, stained with lactophenol-cotton blue to identify fungal structures, covered with a cover slip, scrutinized under a microscope, and classified according to their spore characteristics and colony morphology, drawing on reference materials from atlas books (Rajankar et al., 2007).

3. Results and Discussion

The results displayed in Table (1) identify the species of fungi present in each of the three vegetables grown on PDA medium. The fungi Aspergillus niger, yeast, Penicillium, Alternaria, and Rhodotorula were the most commonly isolated. On the other hand, Demaceous and Mucor were found less frequently.

The amount of bacteria counted in the three vegetables under study—lettuce, celery, and arugula—is displayed in Figure (1) and Table (2). Which had 268 CFU, the highest count of bacteria discovered on celery in the first grocery. With 250 CFU, lettuce contained the most bacteria in the second grocery. Additionally, celery was found to have a higher concentration of bacteria in the third grocery store—280 CFU.

Arugula, celery, and lettuce are the three vegetables that were studied. Figures (2) and (3) show the number of fungi in each of these vegetables. It was found that celery had the highest number of fungi counted in the first studied grocery, at 68 CFU.ml-1. Furthermore, lettuce had the highest number of counted fungi—55 CFU.ml-1—according to the second grocery under study.

The total number of bacteria and the total number of isolated fungi in each of the three vegetables under study are depicted in Figure (3). The findings indicate that there is a higher prevalence of bacterial contamination in vegetables than fungal contamination.

It was evident that the way vegetables were handled in the wet markets was less hygienic, which is why samples from wet markets produced a higher proportion of bacteria. When handling vegetables, handlers did not wear gloves, and the environments and locations for vegetable displays in markets were not hygienic. Improper handling and transportation in contaminated containers can lead to contamination (Chai et al., 2007).

For extended periods of time, a variety of harmful microorganisms can survive in the soil or on crop surfaces and spread to people. Numerous variables, such as soil composition and structure, hygrometry, temperature, light, plant type, and competition from other natural plants and animals, can affect an organism's capacity to survive for an extended amount of time (Leff and Fierer, 2013).

Given the high levels of contamination discovered in our investigation, precautions ought to be taken to lower the possibility of diseases resulting from the low microbial quality of leafy green vegetables. It has been demonstrated that setting up Hazard Analysis and Critical Control Points (HACCP) on vegetable farms may be too successful in lowering the microbiological risks associated with fresh-cut produce (Mei Soon et al., 2012).

In a review of the risks associated with wastewater usage in agriculture, demonstrated that wastewater is being used in the agricultural sector more and more to address freshwater resource depletion and water stress brought on by climate change (Dickin et al., 2015). Future research should take into account multiple exposure routes, long-term health implications, and a wider range of contaminants studied in order to provide a more thorough understanding of the health risks associated with wastewater use in agriculture, especially in areas that heavily rely on wastewater irrigation.

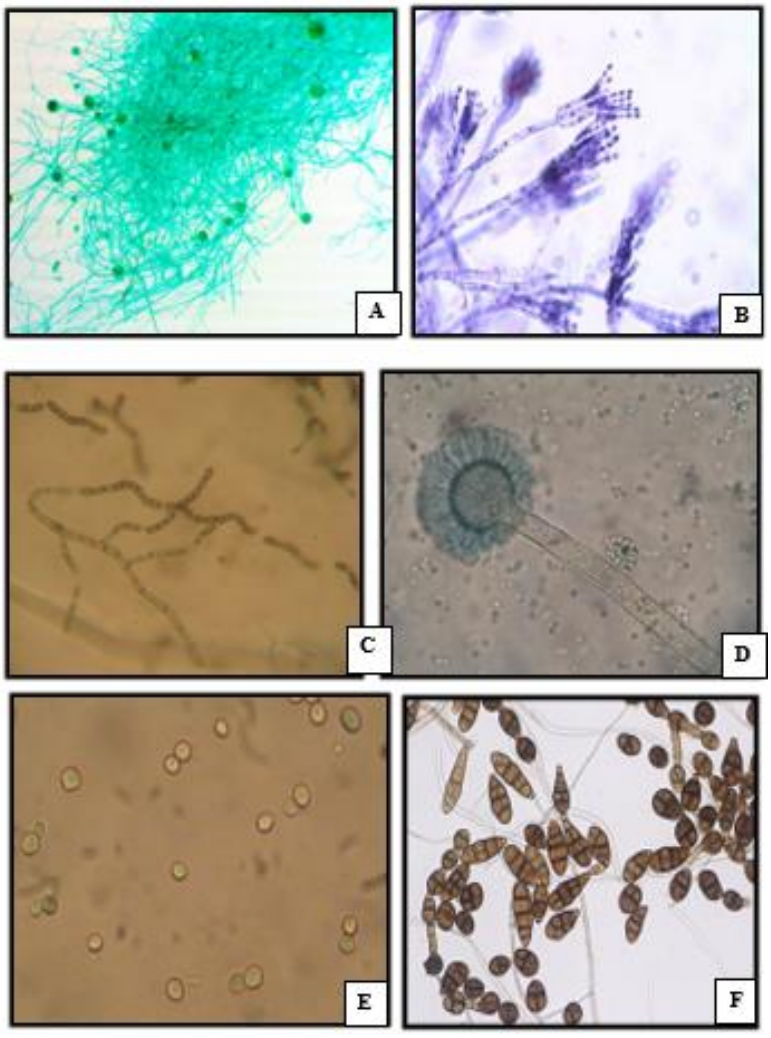

Figure 1: Shows some genera of fungi isolated on PDA medium

A- ***Rhizopus sp.*** **B-** ***Penicillium sp.*** **C-** ***Aspergillus*** **sp.**

D- ***Cladosporium sp.*** **E- yeasts** **F-** ***Alternaria sp.***

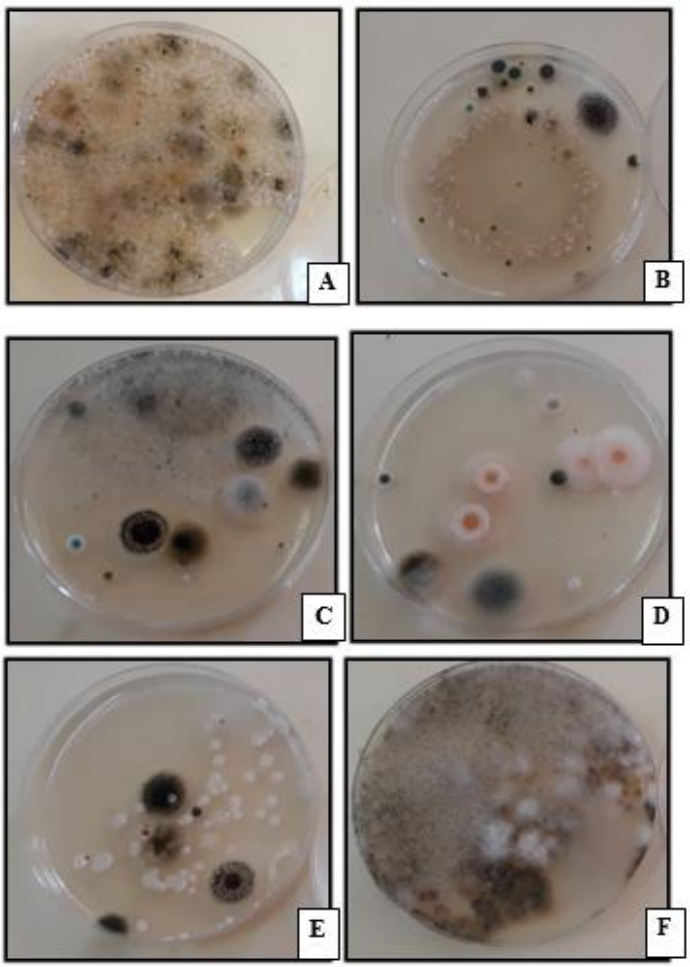

Figure 2 / (A-F): Show different fungal colonies growth on PDA media.

Table 1: Different fungi species in all three studied vegetables.		
Grocery 1	**Grocery 2**	**Grocery 3**
Aspergillus niger	*Penicillium sp.*	*Cladosporium sp.*
Rhizopus sp.	*Aspergillus sp.*	*Aspergillus niger*
Alternaria sp.	*Rhodotorula sp.*	*Alternaria sp.*
Fusarium	*Rhizopus sp.*	*Penicillium sp.*
Penicillium sp.	*Yeast*	*Rhodotorula sp.*
Rhodotorula sp.	*Aspergillus niger*	*Rhizopus sp.*
Yeast	*Fusarium*	*Yeast*
Aspergillus sp	*Demaeous*	
Mucor sp.		

Table 2: Number of counted bacteria in three studied vegetables (CFU).			
Vegetable	**Grocery 1**	**Grocery 2**	**Grocery 3**
Arugula	194	215	251
Celery	268	180	280
Lettuce	240	250	166
Total	702	645	697

Table 3: Variation of fungi count (CFU.ml^{-1}) in in three studied vegetables.			
Vegetable	**Grocery 1**	**Grocery 2**	**Grocery 3**
Arugula	22	36	42
Celery	68	25	15
Lettuce	17	55	45
Total	107	116	102

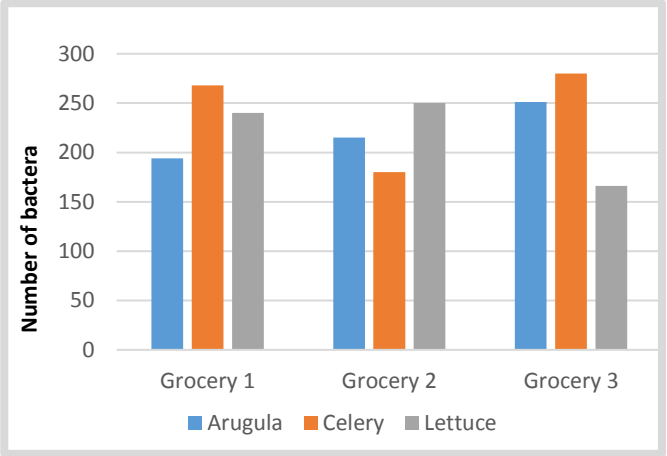

Figure 1: Number of counted bacteria in three studied vegetables

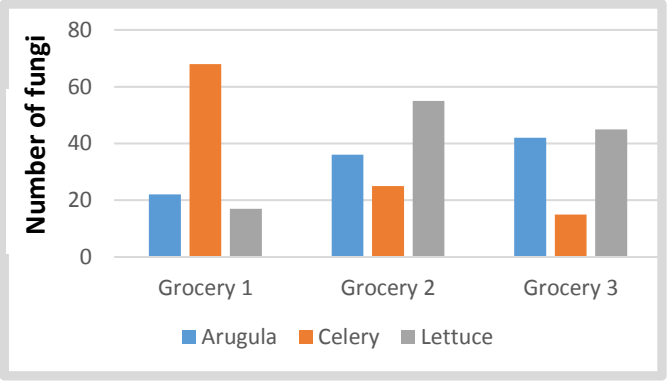

Figure 2: Number of counted fungi in three studied vegetables

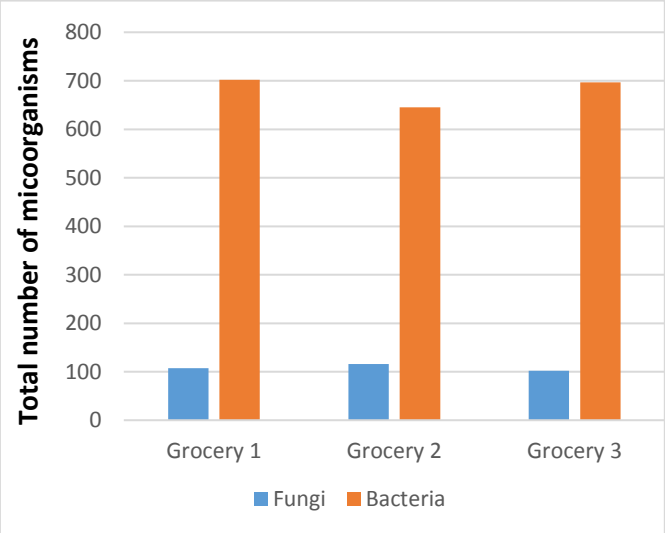

Figure 3: Total number of microorganisms

4. Conclusion

We conclude, based on findings from this study that,

- Microbial contaminations of vegetables evaluated are high, Lettuce, Arugula, and Celery are contaminated with bacteria and fungi.
- Bacterial contaminations of the vegetables are higher than fungal contaminations,
- Poor, unhygienic pre- and post-harvest handling of vegetables contribute significantly to contaminations of vegetables.
- The microorganisms isolated from the vegetables may be pathogenic and/or toxigenic, with the potential of causing foodborne illnesses to consumers. This study provides further impetus to thoroughly investigate the microbiological quality of all kinds of food, whether cooked or raw.
- Prevent using raw wastewater directly for irrigation, by farmers in suburban area.
- Constructing wastewater treatment plant in the farming area to help farmers to use safe water for irrigation purpose.

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