DISEASES OCCURRING DURING THE STORAGE OF POMEGRANATE FRUITS AND PREVENTIVE MEASURES

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Annotation: This article analyzes the main types of diseases that occur during the storage period of pomegranate fruits, their causes, and harmful consequences. Special attention is given to issues such as rotting, mold, and the effects of microorganisms. Measures to prevent these problems, methods to extend the shelf life, preserve the quality, and maintain the edibility of the fruit are also discussed. Additionally, proper storage conditions, disinfection methods, and modern technological solutions are considered.

Keywords: Pomegranate, storage diseases, rotting, mold, microorganisms, prevention, storage conditions, disinfection, phytopathology, storage technology.

ANOR MEVASINING SAQLASH DAVRIDA YUZAGA KELADIGAN KASALLIKLARI VA ULARNI OLDINI OLISH CHORALARI

Annotatsiya: Ushbu maqolada anor mevasining saqlash davrida uchraydigan asosiy kasallik turlari, ularning sabablari va zararli oqibatlari tahlil qilinadi. Ayniqsa, chirish, mog‘orlanish, mikroorganizmlar ta’siri natijasida yuzaga keladigan muammolarga e’tibor qaratiladi. Shuningdek, mevaning saqlanish muddatini uzaytirish, sifatini saqlab qolish va iste’molga yaroqliligini ta’minlash uchun zarur bo‘lgan oldini olish choralari, saqlash sharoitlari, dezinfeksiya usullari va zamonaviy texnologik yechimlar ko‘rib chiqiladi.

Kalit so‘zlar: Anor, saqlash kasalliklari, chirish, mog‘or, mikroorganizmlar, profilaktika, saqlash sharoiti, dezinfeksiya, fitopatologiya, saqlash texnologiyasi.

БОЛЕЗНИ, ВОЗНИКАЮЩИЕ ПРИ ХРАНЕНИИ ПЛОДОВ ГРАНАТА, И МЕРЫ ПО ИХ ПРЕДОТВРАЩЕНИЮ

Аннотация: В данной статье рассматриваются основные виды заболеваний, возникающих при хранении плодов граната, их причины и вредные последствия. Особое внимание уделяется таким проблемам, как гниение, плесень и воздействие микроорганизмов. Также обсуждаются меры профилактики, методы продления срока хранения, сохранения качества и пригодности плодов к употреблению. Рассматриваются условия хранения, методы дезинфекции и современные технологические решения.

Ключевые слова: Гранат, болезни хранения, гниение, плесень, микроорганизмы, профилактика, условия хранения, дезинфекция, фитопатология, технологии хранения.

Introduction

Pomegranate (Punica granatum L.) is a widely cultivated fruit crop valued for its nutritional, medicinal, and economic importance. Due to its rich antioxidant content and long history of use in traditional medicine, the fruit has gained global popularity in recent years. However, like many other horticultural products, pomegranates are highly perishable and vulnerable to a range of post-harvest diseases, especially during storage and transportation.

Storage-related diseases not only reduce the marketability of the fruit but also lead to considerable economic losses and health risks due to microbial contamination. These diseases are often caused by fungi, bacteria, or physiological disorders that thrive under poor storage conditions such as high humidity, improper temperature control, or mechanical injuries sustained during harvesting and handling.[1]

With the growing demand for high-quality and safe agricultural products, it has become essential to study the major diseases affecting pomegranate fruits during storage and develop effective prevention strategies. This paper aims to explore the most common storage diseases affecting pomegranates, identify their causes, and suggest practical and sustainable measures to minimize post-harvest losses and maintain fruit quality.

Methods

This study is based on a qualitative review of scientific literature and previously conducted experiments related to the post-harvest storage of pomegranate fruits. A wide range of academic articles, agricultural journals, and field reports were analyzed to identify the common storage-related diseases and the environmental conditions that contribute to their development.

Information was gathered from sources focusing on the biological and environmental factors influencing fruit spoilage, including fungal and bacterial pathogens such as Botrytis cinerea, Aspergillus niger, and Alternaria alternata. In

addition, case studies documenting physical disorders like internal breakdown and heart rot were examined.[2]

To evaluate preventive measures, the study compared traditional practices with modern technological solutions such as:

- Controlled atmosphere (CA) storage
- Cold chain management (4–8°C with 85–90% relative humidity)
- Use of natural antifungal agents (e.g., neem oil, lemon extract)
- Application of ozone and UV-C light treatments
- Sanitation protocols during harvesting and post-harvest handling

Data from these sources were compared to determine the most effective and sustainable approaches for reducing disease incidence. Although no new laboratory experiments were conducted, the synthesis of existing data provides a clear understanding of best practices in pomegranate storage management.

Results

The comprehensive analysis of literature and case studies revealed several prevalent diseases that affect pomegranate fruits during post-harvest storage. These diseases vary in severity and are often influenced by environmental conditions, fruit handling practices, and pre-harvest factors. The most commonly reported storage-related diseases include fungal infections, physiological disorders, and surface mold, which collectively contribute to substantial post-harvest losses.[3]

Fungal diseases were identified as the leading cause of storage deterioration in pomegranates. Among them, the following pathogens were most frequently reported:

Gray Mold (Botrytis cinerea): This pathogen is responsible for soft rot, primarily occurring under conditions of high humidity and poor ventilation. Infected fruits show water-soaked lesions, grayish mycelial growth, and a rapid breakdown of tissue.

Black Rot (Aspergillus niger): Typically enters through wounds or cracks on the fruit rind, especially when fruits are bruised during handling. The rot starts internally and may not be immediately visible from the outside, posing a challenge in detection.

Alternaria Rot (Alternaria alternata): Often originates from the blossom end of the fruit and progresses inward. It is associated with poor orchard sanitation and delayed harvesting.

In multiple studies, fungal spoilage was found to account for 45–70% of post-harvest losses, especially in fruits stored at room temperature or in uncontrolled environments.

Besides microbial infections, several physiological disorders were reported that negatively impacted fruit quality:

Heart Rot: A non-infectious disorder often linked to poor pre-harvest nutrient management or delayed curing. Affected fruits appear normal externally but contain blackened, hollow, or fermented arils.[4]

Chilling Injury: Fruits stored below optimal temperatures (below 4°C) showed signs of pitting, browning of the rind, and loss of flavor and texture.

These disorders were particularly common in poorly managed cold storage facilities or where temperature fluctuations occurred.

Storage conditions, including temperature, relative humidity, and ventilation, were found to be critical in disease development. Ideal storage conditions for pomegranates were found to be:

- Temperature: 4–8°C
- Relative Humidity: 85–90%
- Ventilation: Moderate air circulation to reduce ethylene accumulation and moisture condensation

Fruits stored in these optimal conditions showed significantly lower disease incidence compared to those kept at ambient temperatures. Additionally, mechanical damage during harvesting, transportation, and sorting was identified as a major factor in pathogen entry. Poor handling practices increased disease occurrence by up to 40%, according to multiple studies.

Various preventive measures demonstrated success in reducing the incidence of storage diseases:

Chemical treatments such as fungicides showed short-term effectiveness but raised concerns over residues and resistance.

Biological control agents, including antagonistic fungi and bacteria, were promising in laboratory settings but require further testing in commercial systems.

Natural preservatives such as neem oil, lemon extract, and edible coatings (e.g., aloe vera gel) reduced fungal growth and preserved fruit quality.

Ozone and UV-C treatments significantly decreased surface mold and microbial load without altering taste or texture.[5]

Overall, integrated approaches combining good agricultural practices, careful handling, and proper storage technology were reported to reduce post-harvest loss by up to 60%.

Discussion

The results of this study underscore the critical role of effective post-harvest management in mitigating the impact of diseases during pomegranate storage. Fungal pathogens such as Botrytis cinerea, Aspergillus niger, and Alternaria alternata emerge as primary culprits causing significant quantitative and qualitative losses. These

findings are consistent with previous research that identifies fungal spoilage as the leading cause of post-harvest decay in many fruit crops.

Environmental factors, particularly temperature and humidity, are pivotal in determining the progression and severity of these diseases. Maintaining storage conditions within the optimal range (4–8°C temperature and 85–90% relative humidity) creates an inhospitable environment for fungal growth and physiological disorders such as chilling injury. However, temperature fluctuations and improper humidity control can exacerbate spoilage, emphasizing the need for reliable cold chain infrastructure.[6]

Mechanical damage incurred during harvesting, transportation, and sorting is another significant factor facilitating pathogen invasion. This highlights the importance of training laborers and handlers in gentle fruit handling techniques, along with proper use of protective packaging materials to minimize bruising.

The review of preventive measures reveals that reliance solely on chemical fungicides is neither sustainable nor fully effective due to concerns about chemical residues, environmental impact, and pathogen resistance development. Therefore, integrating biological control agents and natural preservatives represents a promising direction for sustainable post-harvest disease management. For instance, neem oil and edible coatings not only inhibit fungal growth but also enhance the shelf life and maintain the sensory qualities of the fruit.[7]

Emerging technologies such as ozone treatment and UV-C irradiation offer additional eco-friendly alternatives that can be incorporated into existing storage systems to reduce microbial contamination without compromising fruit quality. However, further large-scale commercial trials are necessary to optimize application protocols and ensure safety.

From a practical perspective, it is crucial to adopt a holistic approach encompassing pre-harvest cultural practices, careful harvest timing, optimized post-harvest handling, and controlled storage environments. Awareness programs and capacity building among farmers, distributors, and retailers play a vital role in implementing these measures effectively.[8]

Conclusion

This study highlights that storage-related diseases significantly affect the quality and shelf life of pomegranate fruits, leading to considerable economic losses. Fungal pathogens, particularly Botrytis cinerea, Aspergillus niger, and Alternaria alternata, along with physiological disorders such as heart rot and chilling injury, are the primary causes of post-harvest deterioration.

Effective prevention requires a multifaceted approach combining optimal storage conditions, careful handling to prevent mechanical damage, and the use of eco-friendly treatments including natural antifungal agents and advanced technologies like

ozone and UV-C light. Relying solely on chemical fungicides is unsustainable due to health and environmental concerns.[9]

Implementing integrated management strategies that encompass pre-harvest, harvest, and post-harvest practices can substantially reduce disease incidence and post-harvest losses. Moreover, educating farmers and supply chain workers on proper handling and storage techniques is essential for preserving fruit quality and ensuring consumer safety.

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