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Mitigating Post-Harvest Losses in Cereals and Pseudo-Cereals: Challenges and Solutions

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SUMMARY

Post-harvest food loss is a leading cause of food insecurity for millions of families across the world. It is estimated that one-third of all food produced for human consumption is lost or wasted, equivalent to 1.3 billion tons (FAO, 2019). Cereals and pseudo cereals play a crucial role in global food security, providing essential nutrients and calories for millions of people. However, they also face several significant challenges that threaten their production, quantity, resilience, quality, and sustainability. These challenges range from processing limitations, infrastructural deficiencies, and socio-economic constraint among others. However, effective post harvest handling play a crucial role in extending the shelf life of cereals and pseudo cereals and reducing postharvest losses, improve market access for farmers, and ensure a stable food supply chain. These postharvest handling requires a multi-faceted approach that encompasses better storage facilities, investments in infrastructure and adoption of appropriate technologies and supportive economic policies among others.

INTRODUCTION

Postharvest losses refer to the reduction in quantity and quality of food between the time of harvest and consumption. According to Gustavsson *et al*. (2019), postharvest losses of cereals and pseudo cereals vary across different regions and commodities, with estimates ranging from 20% to 40% of total production globally (FAO, 2019). Postharvest losses in cereals and pseudo cereals are a critical issue impacting food security, economic stability, and nutritional quality. These losses can occur at various stages, including harvesting, handling, storage, processing, packaging, transportation, and marketing. (FAO, 2019). These losses are most significant in developing countries, where smallholder farmers regularly lose 40% of their harvest due to inadequate storage facilities (Muthayya & Sudha, 2018). Post-harvest handling encompasses a range of activities aimed at preserving the quality and extending the shelf life of agricultural products after they have been harvested. These activities include sorting, grading, cleaning, packaging, storage, and transportation. Cereals and pseudo cereals play a crucial role in global food security, providing essential nutrients and calories for millions of people. Cereals are edible grasses cultivated for their grain, which is a staple food globally due to their carbohydrate-rich nature. They include traditional grains like wheat, rice, maize, barley, and oats. On the other hand, pseudo-cereals are not true cereals because they do not belong to the poaceae (grass) family. Though, they produce seeds that are similar in composition and culinary use to cereals. Examples include quinoa, amaranth, and buckwheat. Postharvest handling of these grains is essential to minimize the losses that occur during storage and transportation. FAO (2010) opined that around 20-30% of grains in developing countries are lost due to inadequate post-harvest handling. According to Riungu *et al.* (2017), effective post-harvest handling of grains are crucial for minimizing losses, maintaining product quality, and ensuring food safety throughout the supply chain. Furthermore, improved practices in drying, storage, and pest control can lead to enhanced food security, reduced food waste, and increased farmers' income (Hodges *et al.*,2011).These grains face several significant challenges that threaten their production, quantity, resilience, quality, and sustainability. These challenges can be grouped into storage issues, transportation inefficiencies, processing limitations, socio-economic constraints, environmental factors, and infrastructural deficiencies. Addressing these challenges will require interdisciplinary approaches that integrate agronomic, genetic, ecological, and socio-economic perspectives to promote resilient and equitable food systems.

Challenges Associated with Postharvest Handling of Cereals and Pseudo Cereals

1. **Infrastructure and Technology Gaps:** The lack of necessary infrastructure, such as drying facilities, cold storage units, hermetic and transportation networks poses a significant challenge in postharvest handling (Ahmed *et al*.2019). Many developing countries suffer from a critical shortage of infrastructure needed for efficient postharvest management. This is compounded by slow adoption of technological advancements like automated monitoring systems and AI-driven predictive maintenance tools, which could significantly reduce postharvest losses.

2. **Genetic Erosion:** The genetic diversity of cereal crops is at risk due to factors such as modern breeding practices, land use changes, and environmental degradation. Genetic erosion can weaken the resilience of cereal crops to pests, diseases, and environmental stresses, limiting their ability to adapt to changing conditions (Khoury *et al.,* 2014).
3. **Economic and Social Factors:** Economic constraints limit farmers' ability to invest in proper storage and processing technologies. Socio-economic issues, such as limited market access, force farmers to sell their produce immediately after harvest at lower prices to avoid losses rather than storing it until market conditions improve. Furthermore, access to markets and distribution channels is often limited for smallholder farmers, as discussed by FAO (2019), leading to increased post-harvest losses and reduced incomes.
4. **Transportation Issues:** Transportation infrastructure is often inefficient, leading to delays and mechanical damage to grains. The lack of coordinated transport networks and the use of inappropriate vehicles exacerbate these problems, contributing significantly to postharvest losses (USAID, 2022).
5. **Processing Limitations:** Traditional processing methods may not effectively remove impurities or prevent pest infestations. High-yielding but pest-susceptible varieties, without corresponding improvements in processing technology, can worsen the problem. Modern techniques like irradiation and ohmic heating are not widely adopted or optimized in many regions (IntechOpen,2023)
6. **Resource Constraints:** Cereal production requires significant inputs of water, land, energy, and agrochemicals, placing strain on finite natural resources. Competition for resources, coupled with growing demand for food, presents challenges for sustainable intensification and equitable access to nutritious cereals (Tilman *et al.,* 2011).

Solutions to Mitigate Postharvest Losses of Cereals and Pseudo Cereals

Several strategies have been proposed to mitigate postharvest losses and improve food availability. Mitigating postharvest losses requires a multi-faceted approach that includes the development of better storage facilities, efficient transportation networks, modern processing technologies, and supportive economic policies. Also, collaborative efforts among governments, private sector stakeholders, and international organizations are essential to drive the necessary changes in postharvest handling of cereals and pseudo cereals (Reygaert, 2021).
1. **Improved Infrastructure:** Inadequate post-harvest infrastructure can result in insect and rodent infestations, microbial infections and harmful changes in moisture content – all of which can lead to losses of produce and livelihoods. However, investing in infrastructure development, such as hermetic structures (hermetic drums, silos, zero fly bags and PICS bags) and efficient transportation systems can help reduce post-harvest losses and maintain product quality of cereals and pseudo cereals (Ahmed *et al.,* 2019).
2. Technology Adoption: Adoption of appropriate technologies, such as modified atmosphere packaging (MAP), can extend the shelf life of agricultural products and minimize quality degradation (Kader, 2005). MAP involves altering the atmosphere surrounding to slow down physiological processes such as respiration, ethylene production and delay spoilage. According to Smith *et al*. (2019), MAP has been shown to effectively prolong the shelf life of agricultural produce by reducing microbial growth.
3. Capacity Building: Providing training and capacity building programs for farmers and stakeholders on proper post-harvest handling techniques, including sorting, grading, and packaging, can improve overall efficiency and reduce losses (FAO, 2019).
4. Market Linkages: Establishing better market linkages and improving access to markets for smallholder farmers through cooperative networks and value chain partnerships can help increase market opportunities and reduce post-harvest losses (Smith *et al.,* 2018)..
5. Nanotechnology: Nanotechnology offers innovative solutions for enhancing the preservation and quality of agricultural produce. Li *et al*. (2020) discuss the application of nano-based materials such as nanoparticles and nanocomposites in post-harvest treatments, including antimicrobial coatings and controlled release systems, which show promise in extending shelf life and reducing spoilage of cereals and pseudo cereals.
6. Robotics and Automation: Advancements in robotics and automation are revolutionizing post-harvest handling operations, leading to increased efficiency and reduced labor costs. It involves Integrating IoT (Internet of Things) devices, sensors, and AI for predictive analytics and automated control of storage environments. This helps in early detection of spoilage and real-time management of storage conditions Research by Zhang *et al.* (2018) highlights the use of robotic systems for sorting, grading, and packaging of agricultural produce, offering precise handling and minimizing damage during processing.

CONCLUSION

Effective post-harvest handling and storage facilities are crucial for maintaining the quality and safety of cereals and pseudo cereals. Spoilage of cereals and pseudo cereals due to insect pests and disease infestation can lead to significant economic losses and pose serious health risks to consumers. Practicing good storage practices, such as proper packaging, labeling, and inventory management, can help prevent these grains from spoilage.

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