



The Critical Role of Post-Harvest Handling in Vegetables

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Abstract. *Postharvest management is a critical phase in the agricultural supply chain, aimed at preserving the quality, safety, and nutritional value of vegetables from harvest to consumption. This study aims to explore the significance of postharvest techniques in minimizing losses and extending the shelf life of vegetables. As methodology, the research process involved a systematic approach to identify, collect, analyze, and interpret relevant information from various sources to gain insights into the research topic. The result showed that various factors, including harvesting methods, storage conditions, transportation, and packaging, influence the quality and quantity of post-harvest produce. By implementing effective postharvest practices, such as proper handling, sorting, grading, and storage, it is possible to reduce food waste, enhance product quality, and increase farmers' income. In conclusion, this review highlights the importance of adopting appropriate postharvest technologies to address the challenges faced by the agricultural sector and ensure a sustainable food supply.*

Keywords: *Handing, losing yield, post harvesting, techniques, vegetable*

Abstrak. *Manajemen pascapanen merupakan fase penting dalam rantai pasokan pertanian, yang bertujuan untuk menjaga kualitas, keamanan, dan nilai gizi sayuran dari panen hingga konsumsi. Penelitian ini bertujuan untuk mengeksplorasi pentingnya teknik pascapanen dalam meminimalkan kerugian dan memperpanjang masa simpan sayuran. Sebagai metodologi, proses penelitian melibatkan pendekatan sistematis untuk mengidentifikasi, mengumpulkan, menganalisis, dan menafsirkan informasi yang relevan dari berbagai sumber untuk mendapatkan wawasan tentang topik penelitian. Hasil penelitian menunjukkan bahwa berbagai faktor, termasuk metode pemanenan, kondisi penyimpanan, transportasi, dan pengemasan, memengaruhi kualitas dan kuantitas produk pascapanen. Dengan menerapkan praktik pascapanen yang efektif, seperti penanganan, penyortiran, pemerangkapan, dan penyimpanan yang tepat, adalah mungkin untuk mengurangi pemborosan makanan, meningkatkan kualitas produk, dan meningkatkan pendapatan petani. Sebagai kesimpulan, tinjauan ini menyoroti pentingnya mengadopsi teknologi pascapanen yang tepat untuk mengatasi tantangan yang dihadapi oleh sektor pertanian dan memastikan pasokan pangan yang berkelanjutan.*

Kata Kunci: *Penanganan, kehilangan hasil, pasca panen, teknik, sayuran*

INTRODUCTION

Vegetables are important sources of vitamins, minerals, and fiber. Vegetables in our diet help us fight against several diseases. Post-harvest management is the technique for saving losses, yield, and nutrition after harvesting vegetables. The post-harvest phase for vegetables is a critical component of the agricultural supply chain, involving a series of steps that ensure vegetables maintain their quality, safety, and nutritional value from harvest to consumption. Effective handling and management practices during this stage are essential to minimize losses, extend shelf life, and deliver a high-quality product to consumers. The phrase “postharvest loss” denotes the reduction in quantity and quality of food products from the time of harvest to consumption. Quality degradation may arise when a product's acceptability, edibility, or nutritional/caloric value is undermined. Quantity losses refer to the reduction in the amount of a product. (Kitinoja, L. and Gorny, 1999), and the management aimed at mitigating these quality or quantity losses is termed post-harvest management. Consumers and all participants in the supply chain bear responsibility for utilizing resources judiciously, protecting the environment, and mitigating the present global food waste rate of 1.3 billion tonnes per year. Fruit and vegetable agriculture constitutes up to 50% of all farmed crops. (Kiaya, 2014). To sustainably nourish the global population in the future, it is imperative to minimize postharvest losses. (Gustavsson, J., Cederberg, C. and Sonesson, 2011). From this perspective, it is imperative to prevent or, at the very least, mitigate losses of fresh fruits and vegetables. Therefore, to mitigate post-harvest losses and improve the qualitative attributes of fresh food for increased consumption, developments in postharvest technologies, including effective harvesting methods and packaging systems, are necessary.

This study aims to explore the significance of postharvest techniques in minimizing losses and extending the shelf life of vegetables.

METHODS

This study is a literature research article. The first step is to identify the data and its source. The researcher began by reviewing existing literature, including journal articles, books, policies, regulations, and reports. Besides this, relevant sources were identified through online research databases like Google Scholar, JSTOR, PubMed, or similar

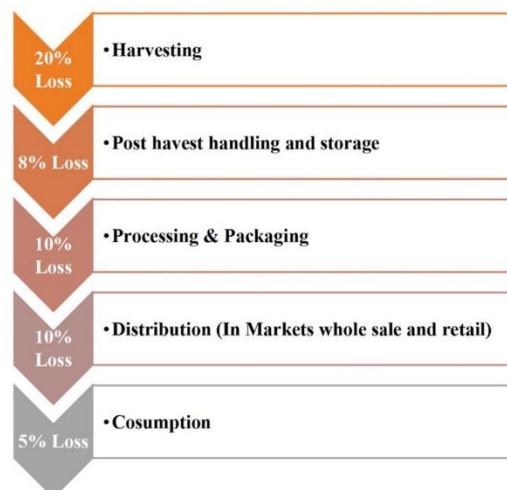
platforms. The researcher explored websites of reputable institutions, government agencies, and non-profit organizations to access relevant documents and reports. Online news articles, blogs, and social media platforms were also consulted for additional insights and current information. Secondly, the researcher obtained copies of identified sources, either through physical libraries, online databases, or direct contact with authors or institutions. The collected materials were carefully read and analyzed to extract relevant information. Third, for data analysis, the research process involved a systematic approach to identify, collect, analyze, and interpret relevant information from various sources to gain insights into the research topic.

RESULTS AND DISCUSSION

Important of harvesting techniques

Post-harvest technology is an important part of agriculture that focuses on preserving and improving the quality of vegetables after they have been harvested, and vegetable crops can earn income and have high bio-nutrition. Postharvest is the key stage in which production can sell and ensure income, and production can be sold dependent on the quality that is made during production motivation postharvest. The process involves a wide range of techniques, including cleaning, sorting, grading, storage, packaging, and transportation. Postharvest management is essential for ensuring food security, reducing food waste, and maximizing the economic benefits of agriculture. (Ghule et al., 2021).

Figure 1. A flow diagram of the fresh fruit and vegetable supply chain illustrating the waste generated at each stage (Elik et al., 2019).



Postharvest loss yield

Postharvest loss refers to the decline in both quantity and quality of food output from the point of harvest to consumption. Quality losses encompass those that impact the nutritious and caloric composition, acceptability, and edibility of a specific product. Such losses are typically more prevalent in industrialized nations. (A. A. Kader, 2002). Quantity losses pertain to the reduction in the amount of a product. Quantity loss is more prevalent in underdeveloped nations. (Kitinoja, L. and Gorny, 1999). A new FAO analysis reveals that, globally, food loss and waste volumes in high-income regions are greater in downstream phases of the food chain, whereas in low-income regions, the opposite is true, with more food lost and wasted in upstream phases. (FAO, 2013). Farmers and vegetable dealers have expressed concerns regarding losses since the inception of vegetable sales. The issue of the quantity of vegetables lost post-harvest due to processing, rotting, pests, rodents, or other factors becomes increasingly significant as global food demand escalates. Mitigating postharvest losses might significantly augment the world food supply, hence diminishing the necessity for further production in the future. (FAO, 2011).

1. Loss yield after harvesting

According to the United Nations, roughly 13% of the food produced around the world is lost between harvest and retail. This has significant costs for farmers, as their hard work yields less income, and for consumers, as their access to vegetables to meet their nutritional needs is restricted. Vegetable loss can range from 9 to 25% of production due to inadequate techniques and harvesting methods. A lack of harvest options leads to a loss in production. Farmers typically absorb postharvest shortages by lowering the sale price and increasing the user's price. (Ews-kt, 2023).

2. Factors post-harvesting losses

Option techniques and strategies aim to reduce post-harvest losses, increase income, and enhance marketing opportunities. The factors of post-harvest losses of vegetables are as follows. (Arends-Kuenning et al., 2022):

A. Harvesting Methods

Harvesting vegetables at the correct maturity is crucial for ensuring they reach the final consumer in optimal condition. However, this timing varies depending on other crop requirements, consumption patterns, and supply chains. For vegetables, ripening at harvest time is the main factor that determines the product quality and shelf life. Some farmers in Cambodia harvest immature crops for economic purposes. (Azabağaoğlu, 2018; Kader, 1995). Postharvest losses are a consequence of the harvesting method. The harvesting period results in losses ranging from 4 to 12% due to an incorrect calculation of harvesting time.

The timing of ripening during harvest is the main factor influencing the quality and shelf life of fruits and vegetables. Some farmers may harvest immature crops due to financial considerations. Unripe fruits exhibit increased susceptibility to mechanical damage and spoilage. Upon ripening, they may present undesirable traits such as elevated acidity and reduced sugar content. Overripe fruits possess a limited shelf life. Fruits exhibit a higher susceptibility to physiological issues in both overripening and under-ripening conditions. Early harvesting of crops results in a decline in both economic and nutritional value. Whole products may occasionally be discarded due to their unsuitability for consumption.

Harvesting techniques may lead to losses. When perishable goods, such as fruits and vegetables, undergo multiple treatments, the associated losses increase. However, during or following the harvest, farmers lacked access to storage containers. Mechanical damage to fruit, vegetables, root, and tuber plants occurs during harvest, resulting in certain losses. (Kasso, M., & Bekele, 2018).

B. Storage

The cooling chain refers to the process of supplying a product from production to consumption while maintaining a specific temperature. The continuous cooling chain for deteriorating vegetables ensures that the product reaches the consumer without nutrient loss. Storage involves

maintaining the quality of agricultural materials and preventing deterioration for a designated period, extending beyond their typical shelf life. Crops are harvested and stored using diverse methods based on their intended use. The grower must understand the harvesting and storage requirements to ensure a quality product, regardless of whether the seed is intended for new plantings the following year, forage processed into livestock feed or for crops developed for specific use. Following the identification of the crop's intended use, the timing of harvest and storage becomes a critical factor. The farmer must assess both the timing of the harvest and the appropriate harvesting method (Jenny Gustavsson, Christel Cederberg, 2010).

A variety of storage structures are utilized globally for the effective storage of horticultural produce. The structure must be maintained at cool temperatures (refrigerated or adequately ventilated and shaded), and the produce placed in storage should possess high initial quality. Storage is crucial for several reasons:

- a) Perishable nature of agriculture & biomaterials
- b) Provision of food materials all year round
- c) Pilling/ provision for large-scale processing
- d) Preservation of nutritional quality
- e) Price control and regulation
- f) Optimization of farmers' gain / financial empowerment of farmers
- g) Opportunity for export market, etc.

C. Transportation

Transportation is a significant factor contributing to losses, especially for perishable goods, as it introduces a time delay between production and consumption. The transportation of perishable foods using refrigerated vehicles is a standard practice in industrialized countries. Failures in the vehicle's cooling system, occurrences of accidents, or delays in loading and unloading areas represent losses in these scenarios. Poor road conditions, inadequate transportation options, and inefficient logistics management hinder the effective preservation of perishable foods

in emerging nations. In these nations, unskilled and uneducated workers, who often handle goods carelessly, perform loading and unloading operations that result in mechanical damage to agricultural products.

D. Improper packaging

Timely and accurate harvesting can significantly reduce losses through the utilization of chilled vehicles for intercity transport, cool storage solutions, and moisture-retentive packaging materials. Farmers sell their products in wholesale or fresh markets. Fresh produce is sold either unpackaged or in bundles at retail outlets. The improper handling of fresh produce on the market, coupled with delays in sales, considerably diminishes its shelf life. Packaging is crucial for reducing losses and extending the shelf life of fresh produce. Improper packaging and the use of unsuitable materials are primary factors contributing to the loss of fruits and vegetables during the post-harvest stages. Inadequately constructed packaging materials fail to effectively protect fresh produce from damage and may accelerate its spoilage. Low-quality packaging materials are often utilized worldwide due to their low cost. The prevalence of inadequate packaging containers is notably higher in emerging and underdeveloped countries. Many delicate fruits and vegetables are packaged in polybags, which adversely affects their quality (Kitinoja, L., & AlHassan, 2010).

E. Understanding market needs

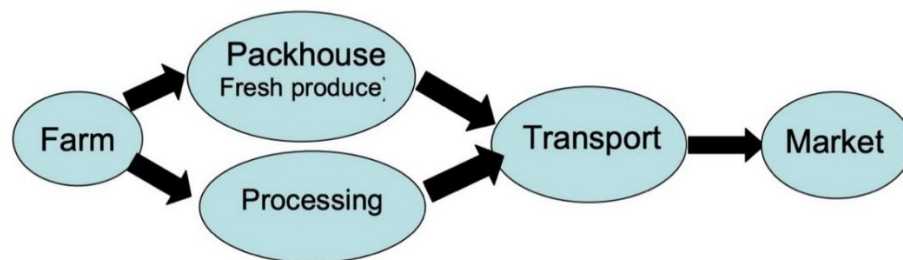
This ensures product disposal at the right time and at the right price but of the right quality.

- a) Quality is the composite of product characteristics that impart value to consumers. Appearance quality is always important. Internal quality (e.g., flavor). Also determines repeat purchases.
- b) Safety is another quality attribute increasingly demanded by consumers. Food safety programs (e.g., Good Agricultural Practices or GAP) should cater to market needs.

F. Integrated Post harvesting techniques

Postharvest techniques are a crucial aspect of modern agriculture, encompassing a range of practices that extend from the moment a crop is harvested to its arrival on the market. These techniques aim to preserve the quality, freshness, and nutritional value of agricultural produce, minimizing losses and ensuring a consistent supply of food. Postharvest management involves a series of carefully coordinated steps, including proper harvesting methods, timely transportation, controlled storage conditions, and appropriate processing and packaging. By implementing effective postharvest techniques, farmers, producers, and retailers can significantly reduce food waste, improve product quality, and enhance consumer satisfaction.

Figure. 2. Post-harvesting techniques from farm to the market



Postharvest techniques are essential to maintaining the quality and extending the shelf life of agricultural products. At the farm level, careful harvesting and field handling practices, such as avoiding damage and minimizing exposure to adverse conditions, are crucial. Once harvested, produce is transported to packhouses where it undergoes a series of processes including cleaning, sorting, grading, sanitizing, microbial control, packaging, cooling, and storage. During transportation, proper loading, unloading, stacking, and protection techniques are implemented to prevent damage and maintain product quality. At the market, products may be re-sorted, re-packed, and stored to ensure freshness and consumer appeal. Finally, for certain products, processing techniques such as drying,

sauce production, and fermentation may be applied to extend shelf life and add value.

Sorting and grading are vital postharvest practices that significantly impact the quality, marketability, and profitability of agricultural products. Separating produce based on factors like size, maturity, and quality helps to prevent microbial contamination and reduce the negative effects of ethylene gas, a natural plant hormone that can accelerate ripening. This process not only facilitates efficient marketing and distribution but also leads to a substantial increase in income, often ranging from 40% to 60%. Skilled workers are essential to ensure accurate sorting and grading. Providing adequate lighting, regular work breaks, and appropriate sorting aids can improve efficiency and reduce errors, ultimately contributing to the overall quality of the final product.

Figure 3. Sorting, sizing and packing of fruit and vegetable



CONCLUSION

Postharvest handling procedures significantly influence the quality and shelf life of horticultural crops following harvest. Given their perishable nature, vegetables should be consumed promptly. Post-harvest treatment techniques can maintain quality when applied judiciously, although they do not substantially enhance it. Significant losses have

occurred due to the lack of implementation of these postharvest management methods. Post-harvest loss can be significantly reduced, and shelf life can be extended through the precise adjustment of postharvest handling techniques. Losses may be reduced by implementing meticulous practices in harvesting, handling, and applying essential cultural techniques, such as storage, packing, and shipping.

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