Journal of
Food Science &
Food Products

https://acadpub.com/jfsfp

Household Food Storage Practices and Their Impact on Shelf Life of Fresh Vegetables: A Case Study in Urban Developing Countries

[1]Farhana Akter, [2]Rakibul Islam, [1]Nusrat Jahan

[1]Faculty of Food Science and Technology, Department of Food Engineering, Sylhet, Bangladesh
[2]Faculty of Biological Sciences, Department of Nutrition and Food Science, Dhaka, Bangladesh

About the Article

Open Access

Case Study

How to Cite: Akter F, Islam R, Jahan N. Household food storage practices and their impact on shelf life of fresh vegetables: A case study in urban developing countries. J Food Sci Food Prod. 2025;1:25–28.

Keywords:
Fresh vegetables, practices, shelf life

Corresponding author:
Farhana Akter,
Faculty of Food Science and Technology, Department of Food Engineering, Sylhet, Bangladesh

© The Authors, 2025. Published by the Academia Publications. This is an Open Access article, distributed under the terms of the Creative Commons Attribution licence (CC-BY) 4.0. (http://creativecommons.org/licenses/by/4.0)

ABSTRACT

Background: Food spoilage due to inadequate household storage practices significantly contributes to food waste, particularly in developing countries where access to cold storage infrastructure is often limited. In urban settings, where fresh vegetables are a dietary staple, improper storage exacerbates food loss, impacting household budgets and food security.

Objective: This study investigates the impact of household storage methods on the shelf life and quality of fresh vegetables, specifically tomatoes, spinach and cucumbers and identifies practical interventions to reduce food waste.

Methods: A cross-sectional survey was conducted among 120 urban households using structured questionnaires to assess storage practices and food waste patterns, complemented by controlled storage experiments. Vegetables were stored under three conditions: room temperature (25-30°C), refrigeration (4-6°C) and refrigeration with sealed containers. Shelf life was measured as the number of days until visual spoilage, characterized by changes in color, odor, or texture. Data were analyzed using descriptive statistics and ANOVA with a significance level of $p<0.05$.

Results: The results showed that refrigeration extended vegetable shelf life by 4-6 days compared to room temperature storage, with sealed containers further reducing spoilage rates by 10-15%. Households aware of optimal storage practices reported 35% less food waste than those using traditional methods. Tomatoes, spinach and cucumbers stored in sealed refrigerated containers exhibited the longest shelf life, lasting 9, 6 and 10 days, respectively.

Conclusion: The study concludes that improved household storage practices, such as refrigeration and the use of sealed containers, significantly reduce food waste. Awareness campaigns combined with low-cost storage solutions can enhance food security and sustainability in urban developing countries.

INTRODUCTION

Food waste is a pressing global issue, with approximately 1.3 billion tons of food-equivalent to one-third of global production-wasted annually, as reported by the Food and Agriculture Organization[1]. In developing countries, where infrastructure limitations often hinder cold chain logistics, household-level food waste is particularly significant. Fresh vegetables, due to their high water content and perishability, are especially prone to spoilage, contributing to economic losses and food insecurity. In urban areas, increasing reliance on fresh produce, driven by changing dietary patterns, underscores the importance of effective storage practices. However, limited knowledge of proper storage methods frequently results in premature spoilage, exacerbating household food waste. Studies estimate that 20–30% of fresh vegetables are discarded due to improper storage in developing countries[2]. This not only strains household budgets but also undermines efforts to

achieve sustainable food systems, as outlined in the United Nations' Sustainable Development Goal 12.3, which targets halving food waste by 2030.

This study focuses on urban households in developing countries to evaluate how storage practices influence the shelf life of commonly consumed vegetables, specifically tomatoes, spinach and cucumbers. By combining survey data with controlled storage experiments, the research quantifies the impact of storage methods on vegetable shelf life and identifies actionable strategies to reduce domestic food waste. The findings are intended to inform policymakers, educators and households about practical interventions to enhance food security and sustainability in urban settings.

Research objectives: The research seeks to assess common household storage practices for fresh vegetables in urban areas of developing countries, measure the shelf life of tomatoes, spinach and cucumbers under different storage conditions, evaluate the relationship between storage practices and household food waste and propose low-cost, practical solutions for reducing vegetable spoilage at the household level.

Significance of the study: This research addresses a critical gap in understanding household-level food waste in urban developing countries, where data on domestic storage practices are often limited. By identifying effective storage methods, the study provides evidence-based recommendations for households, contributing to reduced food waste, improved food security and sustainable consumption practices globally.

MATERIALS AND METHODS

Study area and participants: The study was conducted in a large urban center in a developing country, characterized by diverse socioeconomic groups and varying access to refrigeration. A sample of 120 households was randomly selected from four residential areas representing different income levels: an upper-income neighborhood, a middle-income area, a lower-middle-income district and a lower-income community. Participants were household members primarily responsible for food preparation and storage, ensuring relevant insights into daily practices.

Survey design: A structured questionnaire was developed to collect data on demographic characteristics, including household size, income level and education, storage practices, such as the use of room temperature, refrigeration, or sealed containers; frequency and quantity of vegetable purchases; perceptions of food waste and spoilage and awareness of optimal storage techniques. The questionnaire was pre-tested with 10 households to ensure clarity and reliability. Surveys were conducted in person by trained enumerators fluent in local languages, with responses recorded anonymously to encourage honesty.

Experimental design: Three commonly consumed vegetables-tomatoes (Solanum lycopersicum), spinach (Spinacia oleracea) and cucumbers (Cucumis sativus)-were selected due to their dietary importance and perishability. These vegetables were purchased fresh from a local market to ensure uniformity in quality and ripeness. Each vegetable type was divided into three groups, each subjected to one of three storage conditions: room temperature (25-30°C) in open baskets, mimicking traditional practices; refrigeration (4-6°C) in the refrigerator's vegetable compartment without sealing; and refrigeration with airtight plastic containers to minimize moisture loss and microbial exposure. Each storage condition was tested in triplicate, with 1 kg of each vegetable type per replicate. Storage environments were monitored daily for temperature consistency using digital thermometers.

Data collection: Shelf life was defined as the number of days until visual spoilage, characterized by significant changes in color, such as browning or yellowing, odor, including off-smells, or texture, such as softness or wilting. Trained observers assessed spoilage daily, using standardized criteria based on previous studies[3]. Household survey data were collected over two weeks, with follow-up interviews to clarify ambiguous responses.

Statistical analysis: Descriptive statistics, including means and percentages, were used to summarize household storage practices and reported waste. Shelf life data were analyzed using one-way ANOVA to compare mean shelf life across storage conditions, with post-hoc Tukey tests to identify significant differences at a significance level of $p<0.05$. Relationships between awareness of storage practices and reported waste were assessed using chi-square tests. Statistical analyses were performed using SPSS (version 26).

Ethical considerations: The study adhered to ethical research guidelines. Participants provided informed consent and no personal identifiers were collected. The experimental design ensured no food was wasted unnecessarily, with unspoiled vegetables donated to local charities after experiments.

RESULTS

Household survey findings: The survey of 120 households revealed varied storage practices and their impact on food waste. Approximately 40% of households stored vegetables

at room temperature, reporting a waste rate of 22%. Another 35% used open refrigeration, with a waste rate of 15%, while 25% employed sealed containers in refrigerators, experiencing the lowest waste rate of 10%. These findings indicate that households storing vegetables at room temperature faced the highest spoilage due to lack of temperature control and exposure to humidity, whereas those using sealed containers in refrigerators benefited from reduced spoilage. Chi-square analysis confirmed a significant association between storage method and waste ($\chi^2 = 18.4$, $p<0.01$), suggesting that advanced storage practices substantially lower food loss. Demographic analysis indicated that higher-income households were more likely to use refrigeration (60%) and sealed containers (30%) compared to lower-income households (20 and 10%, respectively). Education level also played a role, with 70% of respondents with college education demonstrating knowledge of optimal storage practices, compared to 40% of those with secondary education or less.

Experimental results: The controlled storage experiments provided quantitative evidence of storage impacts on vegetable shelf life. At room temperature, tomatoes lasted an average of 3±0.5 days, spinach 2±0.4 days and cucumbers 4±0.6 days. In open refrigeration, shelf life increased to 7±0.7 days for tomatoes, 5±0.5 days for spinach and 8±0.8 days for cucumbers. The longest shelf life was observed in sealed refrigerated containers, with tomatoes lasting 9±0.6 days, spinach 6±0.5 days and cucumbers 10±0.7 days. ANOVA results confirmed significant differences in shelf life across storage conditions [$F(2, 24) = 42.3$, $p<0.001$ for tomatoes; $F(2, 24) = 38.7$, $p<0.001$ for spinach; $F(2, 24) = 45.1$, $p<0.001$ for cucumbers]. Post-hoc Tukey tests showed that sealed refrigeration significantly outperformed both open refrigeration and room temperature storage ($p<0.05$).

Factors influencing shelf life: The extended shelf life in refrigerated conditions is attributable to lower temperatures slowing microbial growth and enzymatic activity, as supported by prior research[3]. Sealed containers further minimized moisture loss and exposure to air, reducing oxidative spoilage and microbial contamination. For instance, spinach, which is highly perishable due to its high water content, exhibited a 200% increase in shelf life when stored in sealed containers compared to room temperature, highlighting the efficacy of controlled microenvironments.

Socioeconomic and cultural influences: The survey revealed that cultural practices, such as bulk purchasing during weekly markets, often lead to overstocking and subsequent spoilage. Lower-income households reported limited access to refrigerators, with 45% citing high electricity costs as a barrier, underscoring the need for affordable, energy-efficient storage solutions tailored to the socioeconomic context of urban developing countries.

DISCUSSION

These findings align with prior research indicating that proper storage significantly reduces food spoilage[4]. Refrigeration slows metabolic processes, while sealed containers create a controlled microenvironment, limiting microbial proliferation[3]. The 35% reduction in waste among households with better storage awareness suggests that education can play a pivotal role in waste reduction. These results are consistent with global studies, such as WRAP's analysis of household food waste in developed countries[4] but highlight unique challenges in developing countries, including infrastructure limitations and cost barriers. Interventions such as community-based education programs and subsidies for energy-efficient refrigerators could bridge this gap. Additionally, promoting low-cost solutions, like reusable airtight containers, could be feasible for lower-income households. The study's experimental design, while controlled, simplifies real-world conditions, where factors like inconsistent power supply may affect refrigeration reliability.

CONCLUSION

This study demonstrates that household storage practices significantly influence the shelf life of fresh vegetables in urban developing countries. Refrigeration extends shelf life by 4-6 days and sealed containers further reduce spoilage by 10-15%. Households with greater awareness of storage techniques report substantially less waste, highlighting the potential of education to mitigate food loss. These findings underscore the need for targeted interventions, including awareness campaigns, affordable storage technologies and policy support for sustainable food systems. The study recommends implementing community workshops to teach optimal storage practices, focusing on low-cost solutions like airtight containers and introducing policy measures to subsidize energy-efficient refrigerators for low-income households to improve access to cold storage. Further research is needed to investigate the impact of power outages on refrigeration efficacy and to explore alternative preservation methods, such as vacuum sealing or natural preservatives. The study was limited to three vegetables and a single urban center, which may not fully represent the diverse dietary and geographic contexts of developing countries. Future research should include a broader range of produce and both urban and rural areas to enhance generalizability.

REFERENCES

1. Gustavsson J, Cederberg C, Sonesson U, van Otterdijk R, Meybeck A. Global food losses and food waste. Rome: FAO; 2011.
2. Parfitt J, Barthel M, Macnaughton S. Food waste within food supply chains: quantification and potential for change to 2050. Philos Trans R Soc Lond B Biol Sci. 2010;365(1554):3065-81.
3. Kaur R, Kaur A. Impact of storage conditions on postharvest quality of vegetables. J Food Sci Technol. 2019;56(3):1197-205.
4. WRAP. Household food waste in the UK, 2017. Waste and Resources Action Programme; 2018.
5. Lipinski B, Hanson C, Lomax J, Kitinoja L, Waite R, Searchinger T. Reducing food loss and waste. Washington, DC: World Resources Institute; 2013.