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Comparative Analysis of Drying Techniques to Assess the Shelf Life Extension of Apple Varieties

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Abstract

This study investigates the comparative efficacy of two dehydration methods, solar tunnel drying and hot air cabinet drying, in enhancing the shelf life of three apple cultivars: Gala, Red Delicious, and Golden Delicious. Drying processes were conducted over intervals of 12, 15, 18, 21, and 24 hours to identify the optimal drying duration for each method and cultivar. Both techniques significantly reduced moisture content, thereby extending shelf life; however, notable differences in drying efficiency and product quality were observed. Hot air cabinet drying, characterized by consistent and controlled environmental conditions, facilitated a more uniform reduction in moisture content. Treatment T5 (hot air cabinet, 24 hours) consistently achieved the lowest moisture content across all time points, whereas, T6 (solar tunnel, 12 hours) exhibited the highest residual moisture levels but demonstrated superior preservation of nutritional constituents, particularly minerals. Hot air cabinet drying also maintained the apples' original color and flavor more effectively, benefiting from its independence from solar radiation variability. In contrast, solar tunnel drying was more cost-effective and environmentally friendly. Optimal drying times varied by cultivar: Red Delicious and Gala required 12-15 hours (hot air) and 24 hours (solar tunnel), whereas, Golden Delicious achieved optimal results at 18 hours (hot air) and 21 hours (solar tunnel). The study concludes that hot air cabinet drying for 15 hours is most effective for maximizing shelf life and quality, yielding moisture contents of 12.2% for Golden Delicious, 13.0% for Red Delicious, and 11.5% for Gala. These findings underscore the trade-offs between drying efficiency, product quality, and environmental sustainability, providing valuable insights for optimizing dehydration processes in apple preservation.

Keywords: *Apple; Drying, Hot air drying, Solar drying, Shelf life extension, Environmental Sustainability*