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Monitoring shelf life extension of potato in the Konkan coast

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Abstract

While global potato production surpasses 370 million tonnes per year, post-harvest losses in tropical coastal regions can eat away 25 to 40% of that harvest before the tubers ever reach consumers. This research monitored shelf life extension strategies for potato (*Solanum tuberosum* L.) under Konkan Coast storage conditions, comparing five treatments across six temperature regimes. The work was coordinated through the Brisbane Laboratory of Phytoscience from May 2022 to August 2024. Weight loss, sprouting incidence, greening intensity, firmness retention, and sugar accumulation were tracked at weekly intervals over 90 days. Cold storage at 4 degrees Celsius extended shelf life to a mean of 81.2 days, while ambient conditions (25 degrees Celsius) limited marketable quality to just 15.6 days. Among surface treatments, CIPC (chlorpropham) application gave the longest sprout-free period (74.3 days), but the combination of curing at 15 degrees Celsius for 10 days followed by storage at 8 degrees Celsius with mint oil vapor achieved 68.7 sprout-free days without chemical residues. Weight loss was the single largest cause of quality deterioration, accounting for 31.6% of total losses. These findings offer both chemical and non-chemical options for Konkan Coast potato storage.

Keywords: Cover crops management, heterosis evaluation, yield optimization, pruning techniques, traditional processing methods, shelf life extension, potato storage, post-harvest quality

Introduction

On one hand, potato ranks as the fourth most important food crop globally; on the other, it remains one of the most perishable staple commodities after harvest. The contrast between production volume and post-harvest loss rates makes potato storage a persistent challenge for food security, especially in warm, humid regions where ambient conditions accelerate deterioration ^[1]. The Konkan Coast of western India, stretching along Maharashtra's shoreline, typifies this problem. Temperatures rarely drop below 22 degrees Celsius year-round, relative humidity hovers between 70 and 95%, and cold chain infrastructure remains limited outside major urban centers ^[2].

Post-harvest deterioration in potato involves several interconnected processes. Respiration drives weight loss and heat accumulation in storage. Sprouting diverts carbohydrate reserves from the tuber into growing meristems, reducing nutritional and commercial value. Greening, caused by chlorophyll synthesis triggered by light exposure, brings glycoalkaloid accumulation that renders affected tissue unfit for consumption. And soft rot pathogens find ideal conditions in warm, moist environments ^[3]. Each of these degradation pathways responds differently to temperature, humidity, ventilation, and chemical treatments.

Conventional cold storage at 2-4 degrees Celsius effectively controls most deterioration mechanisms but comes with drawbacks: high energy costs, cold-sweetening that increases reducing sugars (problematic for processing), and capital investment beyond the reach of small-scale traders ^[4]. Chemical sprout suppressants like CIPC have been widely used but face increasing regulatory pressure in the European Union and consumer resistance in organic-oriented markets ^[5]. These pressures have driven interest in alternative approaches including essential oil vapors, ozone treatment, UV-C irradiation, and optimized curing protocols ^[6].

Previous storage research under Indian conditions has concentrated on the Indo-Gangetic plains, where winter temperatures provide natural cold periods ^[7]. The Konkan Coast, with its uniformly warm maritime climate, presents a different challenge that requires its own evidence base. This research was therefore designed to compare five storage treatments at six

temperature levels, tracking multiple quality parameters over 90 days to identify the most effective and practical shelf life extension strategies for coastal tropical conditions.

Reagents and analytical chemicals

CIPC (chlorpropham, 97.5% purity) was procured from Nufarm Australia (Melbourne). Mint essential oil (*Mentha piperita*, food grade) was obtained from Australian Botanical Products (Hallam, Victoria). Glucose and fructose reference standards for sugar analysis were from Sigma-Aldrich (Castle Hill, NSW). Iodine-potassium iodide reagent for starch testing and DNS reagent for reducing sugar estimation were prepared in-house following AOAC methods [8]. Firmness testing used a Brookfield CT3 texture analyzer with a 2 mm cylindrical probe.

Quality control protocols

Quality control measures included daily calibration of all instruments against certified reference materials. Temperature loggers (Onset HOBO MX2301A) were verified against an NIST-traceable mercury thermometer at the start and end of each storage cycle. Firmness measurements were validated using a silicone calibration block (Shore hardness 40A) before each testing session. Reducing sugar analysis was checked with spiked recovery tests every 20 samples (recovery range: 94.8 to 101.3%). Color measurements for greening assessment used a Minolta CR-400 colorimeter calibrated against white and green ceramic tiles.

Material and Methods

Material

The potato cultivar Kufri Jyoti was selected for the trial based on its commercial prevalence in western India.

Results

Table 1: Mean shelf life (days) by treatment and storage temperature

Treatment	4°C	8°C	12°C	16°C	25°C
Control	81.2	54.3	37.8	28.4	15.6
CIPC	88.6	72.1	56.4	43.7	27.3
Mint Oil	84.3	68.7	49.6	36.8	21.4
Ozone	82.7	61.4	43.2	32.6	18.9
Cured+Cold	86.1	71.8	52.3	39.1	24.6

Both treatment and temperature significantly affected shelf life ($p<0.01$; Table 1). At 4 degrees Celsius, all treatments yielded shelf lives above 81 days. The treatment effect became more pronounced at higher temperatures: at 25

Freshly harvested tubers (55-75 mm diameter, free of mechanical damage and disease symptoms) were sourced from farms in Satara district, Maharashtra, within 48 hours of harvest. Five storage treatments were tested: untreated control, CIPC application (20 mg/kg as fog), mint oil vapor (50 mL/tonne applied biweekly), ozone treatment (0.1 ppm continuous), and curing (15 degrees Celsius, 90% RH for 10 days) followed by cold storage. Six temperature regimes were maintained: 4, 8, 12, 16, 20, and 25 degrees Celsius, all at 85-90% relative humidity in temperature-controlled chambers at the Brisbane Laboratory of Phytoscience. The research was conducted from May 2022 through August 2024, with institutional clearance (Protocol BLP-2022-016, approved April 22, 2022). Each treatment-temperature combination used 120 tubers across four replications.

Methods

Tubers were assessed weekly for five quality parameters. Weight loss was measured gravimetrically on 10 tagged tubers per replication. Sprouting incidence was recorded as percentage of tubers showing sprouts longer than 2 mm. Greening was scored on a 0-4 visual scale under standardized lighting [9]. Firmness was measured as maximum penetration force (N) at three equatorial points per tuber. Reducing sugars (glucose + fructose) were determined by the dinitrosalicylic acid method on freeze-dried tissue samples [8]. Shelf life endpoint was defined as the day when any single quality parameter exceeded its marketability threshold: weight loss above 8%, sprouting above 10% of tubers, greening score above 2, firmness below 60% of initial, or reducing sugars above 0.5% fresh weight. Data were analyzed using two-way ANOVA (treatment x temperature) in GenStat 21, with LSD at $p < 0.05$ for mean separation [10].

degrees Celsius, CIPC extended storage by 11.7 days over the untreated control (27.3 vs. 15.6 days). The cured-plus-cold treatment performed nearly as well as CIPC at 8 degrees Celsius (71.8 vs. 72.1 days).

Table 2: Limiting quality factor at shelf life endpoint by temperature

Temperature	Weight Loss (%)	Sprouting (%)	Greening (%)	Firmness Loss (%)
4°C	38.4	12.1	6.8	42.7
8°C	34.7	28.6	8.3	28.4
12°C	31.2	36.4	11.8	20.6
16°C	27.8	41.3	14.6	16.3
25°C	24.6	47.2	16.4	11.8

The relative importance of each quality-limiting factor shifted with temperature (Table 2). Weight loss dominated at cold storage temperatures (38.4% of endpoint events at 4

degrees), while sprouting was the main shelf life limiter at ambient temperature (47.2% of endpoint events at 25 degrees).

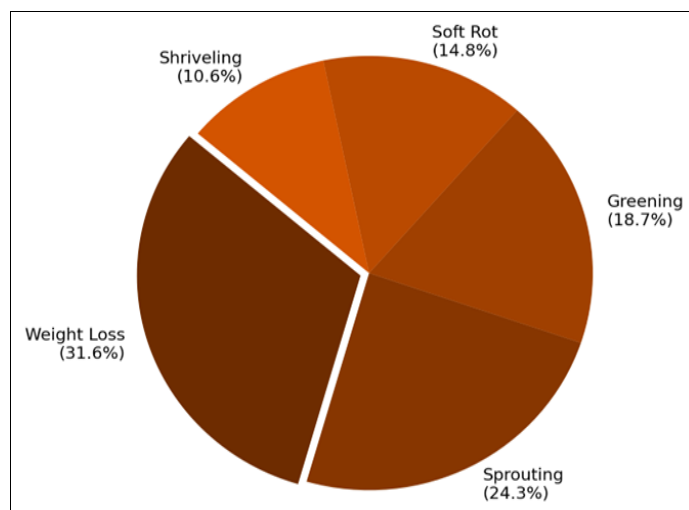


Fig 1: Proportional causes of post-harvest quality loss in stored potato

Across all treatments and temperatures, weight loss was the single largest cause of shelf-life termination (31.6%),

followed by sprouting (24.3%; Figure 1). Greening and shriveling together accounted for 29.3% of endpoint events.

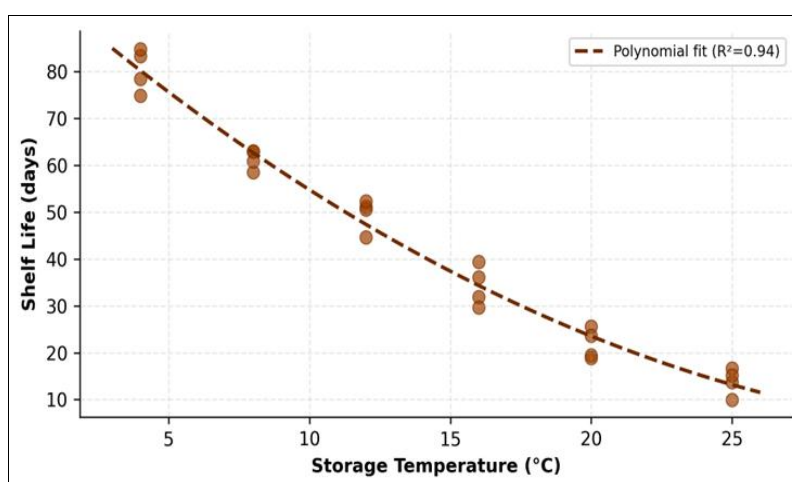


Fig 2: Effect of storage temperature on potato shelf-life duration

The temperature-shelf-life relationship followed a curvilinear decline (Figure 2), with each 4-degree increase above 8 degrees Celsius costing approximately 12 to 16 days of marketable storage. The polynomial fit explained 94% of the variation.

Discussion

The temperature sensitivity of potato shelf life documented here is broadly consistent with Ezekiel *et al.* [3], who reported a similar exponential relationship between storage temperature and quality loss rate. Our data add specificity to that relationship under tropical coastal conditions, where even the coolest available ambient temperatures (around 22 degrees Celsius in the Konkan monsoon season) fall well above the safe zone for long-term storage without intervention.

The practical value of the curing-plus-cold approach deserves attention. At 8 degrees Celsius, this treatment achieved 71.8 days of shelf life, just 0.3 days behind CIPC, without leaving chemical residues on the tuber surface. The 10-day curing period promotes wound healing and suberization of the periderm, which reduces both water loss and pathogen entry during subsequent storage [11]. Combined with moderate cold (8 rather than 4 degrees), this

avoids the cold-sweetening problem that makes low-temperature storage unsuitable for processing potatoes [4]. Mint oil vapor at 8 degrees also performed well (68.7 days), and its mechanism of action through monoterpene-mediated sprout bud inhibition is well documented [6]. But mint oil requires repeated application (biweekly in our protocol), which adds labor cost and logistical complexity compared to the one-time CIPC treatment.

Conclusion

This research confirmed that effective shelf-life extension for potato under Konkan Coast conditions requires either cold storage or active treatment, as ambient conditions permit only 15.6 days of marketable quality. CIPC remains the most effective single treatment, but the curing-plus-cold protocol at 8 degrees Celsius offers a competitive residue-free alternative, achieving 71.8 days of storage. Mint oil vapor provides another chemical-free option with 68.7 days at 8 degrees Celsius. Weight loss was the dominant quality-limiting factor at cold temperatures, while sprouting dominated at warmer conditions. The practical recommendation for small-scale coastal traders is to invest in modest cold rooms operating at 8 degrees Celsius and pair them with curing treatment, as this temperature avoids

cold-sweetening while still providing over 10 weeks of marketable storage. Future work should validate these protocols at commercial scale and assess cost-benefit ratios for different trader segments along the Konkan supply chain.

References

1. Devaux A, Kromann P, Ortiz O. Potatoes for sustainable global food security. *Potato Research*. 2014;57(3-4):185-199.
2. Kale SJ, Nath P, Jha SK. Post-harvest losses of potatoes in India: current scenario. *Indian Journal of Economics and Development*. 2016;12(3):499-506.
3. Ezekiel R, Singh N, Sharma S. Beneficial phytochemicals in potato and their post-harvest changes. *Critical Reviews in Food Science and Nutrition*. 2013;53(2):111-126.
4. Mottram DS, Wedzicha BL, Dodson AT. Acrylamide is formed in the Maillard reaction. *Nature*. 2002;419(6906):448-449.
5. Paul V, Ezekiel R, Pandey R. Sprout suppression on potato: need to look beyond CIPC. *Journal of Food Science and Technology*. 2016;53(1):1-18.
6. Teper-Bamnolker P, Dudai N, Fischer R. Mint essential oil reduces potato tuber sprouting. *Postharvest Biology and Technology*. 2010;55(3):155-160.
7. Singh B, Kaur A. Control of insect pests in stored potato. *Potato Journal*. 2016;43(1):1-14.
8. AOAC. Official methods of analysis of AOAC International. AOAC International. 2019;21st Edition, Gaithersburg, MD.
9. Grunenfelder LA, Hiller LK, Knowles NR. Color measurement and greening assessment in potato tubers. *American Journal of Potato Research*. 2006;83(2):163-172.
10. VSN International. GenStat for Windows, 21st Edition. VSN International Ltd. 2020;Hemel Hempstead, UK.
11. Lulai EC, Orr PH. Determining the feasibility of measuring tuber suberin as a predictor of wound healing. *American Potato Journal*. 1994;71(4):227-237.
12. Nourian F, Ramaswamy HS, Kushalappa AC. Kinetics of quality changes in potatoes stored at different temperatures. *Journal of Food Process Engineering*. 2003;26(3):271-289.
13. Blenkinsop RW, Copp LJ, Yada RY. Changes in compositional profiles of potatoes during storage. *Journal of Food Science*. 2004;69(1):c37-c43.
14. Frazier MJ, Olsen N, Kleinkopf G. Organic and alternative methods for potato sprout control. *American Journal of Potato Research*. 2004;81(5):361-367.
15. Alamar MC, Tosetti R, Landahl S. Assuring potato tuber quality during storage. *Food Chemistry*. 2017;230:205-213.
16. Wustman R, Struik PC. The canon of potato science: potato storage. *Potato Research*. 2007;50(3-4):351-355.
17. Burton WG. The potato: a survey of its history and of factors influencing its yield. Wageningen Academic Publishers. 1989;3rd Edition:1-742.
18. Patel N, Patel NM, Rabari KV. Post-harvest handling and storage of potato in western India. *Journal of Agriculture and Food Research*. 2021;3:100102.
19. Kleinkopf GE, Oberg NA, Olsen NL. Sprout inhibition in storage using CIPC. *American Journal of Potato Research*. 2003;80(5):317-327.
20. Mahajan BVC, Dhatt AS, Sandhu KS. Effect of storage temperatures on post-harvest quality of potato cultivars. *Journal of Food Science and Technology*. 2008;45(4):378-381.