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Extending the Shelf Life of Tomatoes in Nigeria Using Edible Coatings from Locally Available Materials

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Abstract: Postharvest losses of tomatoes in Nigeria are exceptionally high, with over 50% of the harvest lost to spoilage due to inadequate storage and handlingcanr.msu.edu. Edible coatings offer a promising, low-cost technology to extend tomato shelf life by creating a thin barrier against moisture loss and microbial attack. This article reviews the use of edible coatings derived from locally available Nigerian materials – cassava starch, aloe vera gel, and chitosan – to prolong tomato freshness. We assess recent studies in Nigeria and similar tropical contexts, highlighting that cassava starch-based composite coatings can delay ripening and quality degradation for up to four weeks researchgate.netresearchgate.net, aloe vera gel coatings can significantly reduce weight loss and decay over 3–4 weeks iiardjournals.org, and chitosan-based coatings (alone or in combination with starch) effectively curb microbial growth and nutrient loss for 12–14 days or more food.actapol.netfood.actapol.net. The technological feasibility of these biopolymer coatings in Nigeria is discussed in terms of material availability (e.g. Nigeria's abundant cassava supply), scalability for farmers and markets, and potential adoption challenges such as cost, awareness, and application methods. While laboratory results are encouraging – showing slower ripening, reduced spoilage, and extended shelf life – key gaps remain in scaling up these solutions. The review identifies the need for field trials, economic analyses, and farmer education to transition edible coating technology from research to practice in Nigeria's tomato value chain. In conclusion, edible coatings from cassava starch, aloe vera, and chitosan present an environmentally friendly strategy to reduce postharvest tomato losses in Nigeria, improving food security and farmers' incomes, but concerted efforts in research and extension are required to realize their full potential.

Keywords: Tomato; shelf life; postharvest; aloe vera coating; tropics;

Introduction

Tomato (*Solanum lycopersicum* L.) is a critical vegetable crop in Nigeria, both for its nutritional value and its economic importance to smallholder farmers. However, tomatoes are highly perishable; without proper storage, they can spoil within days under tropical conditions. Nigeria produces approximately 1.8 million tonnes of tomatoes annually, yet over 50% of this yield is lost postharvest due to inadequate storage, transportation, and processing infrastructurecanr.msu.edu. These losses threaten national food security and farmer livelihoods, contributing to seasonal scarcities and the need for costly importscanr.msu.edu. The short shelf life of fresh tomatoes is exacerbated by Nigeria's warm, humid climate and limited cold chain facilities – most rural farmers lack refrigeration due to unreliable electricity supplyajol.info. Consequently, harvested tomatoes must be sold immediately or risk rapid deterioration, leading to glut-and-scarcity cycles and substantial waste.

Edible coatings have emerged as a promising postharvest technology to extend the shelf life of fruits and vegetables in tropical regions. An edible coating is a thin layer of consumable material applied on the surface of produce, serving as an extra protective skin. These coatings act as semi-permeable barriers to moisture and gas exchange, thereby slowing down respiration, water loss, and microbial invasion in produceiiardjournals.org. By creating a modified atmosphere around the fruit, edible coatings can delay ripening and reduce the growth of spoilage organisms without relying on refrigeration or hazardous chemicals. For example, aloe vera gel, a natural mucilaginous extract, has been used to preserve fresh fruits by sealing in moisture and even imparting antimicrobial effectsiiardjournals.org. Chitosan, a biopolymer derived from chitin in crustacean shells, is another well-studied edible coating known for its antifungal properties and film-forming ability. Starch from various crops (e.g. cassava, corn) can also be made into a biodegradable coating that is colorless, tasteless, and safe to eatsciencedirect.com.

Importantly, Nigeria is well-endowed with resources to produce these edible coating materials locally. The country is the world's largest producer of cassava, yielding around 53–60 million tonnes annuallycbn.gov.ng, which provides a cheap and abundant source of starch. Aloe vera plants grow in Nigeria's climate and are used traditionally for medicinal and cosmetic purposes, making aloe gel a readily available coating substrate. Chitosan can be synthesized from the waste shells of shrimp, crabs, and other seafood processed in Nigeriasciencedirect.comresearchgate.net. Utilizing such locally available materials for postharvest coatings aligns with Nigeria's need for low-cost, sustainable interventions to reduce food losses.

This paper provides a comprehensive review of how cassava starch, aloe vera gel, and chitosan-based edible coatings can extend the shelf life of fresh tomatoes in Nigeria. We summarize the findings of existing studies conducted in Nigeria and comparable tropical contexts, evaluate the technological feasibility (materials, scalability, and adoption considerations) of these coatings in the Nigerian tomato value chain, and identify key gaps for future research. By focusing on indigenous materials and conditions, this review highlights practical strategies for Nigeria to mitigate tomato postharvest losses through innovative, eco-friendly coating technologies.

Literature Review

Cassava Starch-Based Edible Coatings

Starch-based coatings are widely studied for produce preservation due to their good film-forming properties and biodegradability. Cassava starch is particularly attractive in Nigeria's context given its local abundance and low cost. Edible films made from cassava starch are generally colorless, odorless, and safe for consumptionsciencedirect.com. However, pure starch films can be brittle; thus plasticizers (like glycerol) and other additives are often incorporated to improve flexibility and barrier function. Recent research in West Africa has demonstrated the efficacy of cassava starch composite coatings on tomatoes. Adjouman et al. (2018) in Côte d'Ivoire formulated two composite coatings from "improved" cassava starch mixed with vegetable oil, soy lecithin, glycerol, and cellulose derivativesresearchgate.net. Tomatoes coated with these cassava-starch composites and stored at ~20 °C showed significantly delayed changes in quality attributes (firmness, weight loss, acidity, soluble solids, and color) compared to uncoated tomatoes or those treated with a commercial coating (Semperfresh™)researchgate.net. The cassava-based coatings effectively slowed down ripening and dehydration, allowing the tomatoes to remain marketable for up to four weeks at room temperatureresearchgate.net. This four-week shelf life is about double the typical 2-week limit for untreated tomatoes under similar conditions. The results demonstrate that a starch derived from local cassava varieties, combined with edible additives, can perform as well as or better than imported commercial coatings in extending tomato shelf life.

Nigerian researchers are also exploring cassava starch as a base for edible coatings. Ossamulu et al. (2023) combined cassava starch with chitosan to create a composite coating (described further below under chitosan) that proved highly effective for preserving tomatoes and eggplantsfood.actapol.netfood.actapol.net. Another study evaluated a thermoplastic cassava starch coating on tomatoes and reported a clear extension of shelf life compared to conventional (uncoated) handlingijmpronline.com. These findings underscore the potential of cassava starch – a resource Nigeria has in abundance – as a key ingredient in edible coatings. The film-forming ability of cassava starch provides a moisture barrier that reduces shriveling of tomatoes, while its permeability to gases can be tuned (via additives) to slow respiration without causing anaerobic off-flavors. A practical advantage is that cassava starch coatings could be produced by local agro-industries (e.g., cassava processing centers) and supplied to tomato farmers or traders as an inexpensive dipping solution. However, pure starch coatings do not inherently combat microbial spoilage, so researchers often enrich them with antimicrobial agents (like organic acids or plant extracts) or blend them with other biopolymers (such as chitosan) to enhance functionalityift.onlinelibrary.wiley.comsciencedirect.com. Overall, the literature suggests that cassava starch-based coatings are technically feasible and effective for extending tomato shelf life in tropical ambient conditions, though optimization of formulations (for example, starch-oil composites or starch-nanoparticle films) could further improve outcomes.

Aloe Vera Gel Coatings

Aloe vera gel, extracted from the fleshy leaves of the aloe plant, has gained attention as a natural edible coating for fresh produce. Aloe vera gel consists mostly of polysaccharides and water, forming a clear, mucilaginous coating that can slow moisture loss and modulate gas exchange. It also contains bioactive compounds with antimicrobial and antioxidant properties, which can help suppress decay and maintain quality. In Nigeria, aloe vera is available in many regions and could be harnessed as a low-cost coating material for smallholders. Several studies in Nigeria and similar climates have shown aloe vera coatings to markedly prolong tomato shelf life.

Adia et al. (2024) conducted an experiment in Benue State, Nigeria, applying aloe vera gel in different quantities (1 mL, 3 mL, 5 mL per fruit) to freshly harvested tomatoes and storing them at room temperature for 21 daysiiardjournals.org. The aloe-coated tomatoes had significantly lower spoilage and weight loss than the uncoated controls. By day 21, the control tomatoes suffered 77.5% decay (over three-quarters of fruits spoiled) with an average weight loss of ~45.9 g per fruit, whereas the best treatment (1 mL aloe gel coating) saw only 30% of fruits spoiled and ~6.8 g weight lossiiardjournals.org. In other words, the aloe coating kept 70% of the tomatoes sound after 3 weeks, a remarkable improvement over the near-total loss in untreated tomatoes. The intermediate aloe treatments (3 mL and 5 mL) had slightly higher spoilage rates (37–52%), suggesting that excessive gel might create too humid an environment on the fruit surfaceiiardjournals.orgiiardjournals.org. The study concluded that a thin application of aloe vera gel was most effective in extending shelf life, primarily by reducing moisture loss and slowing microbial decayiiardjournals.org. The aloe coating likely acts by sealing small wounds and pores on the tomato skin and may impart some antimicrobial effect, thus delaying the onset of rot.

Similarly, Olorunsogo (2023) reported that unripe tomatoes coated with aloe vera gel remained fresh and firm for four weeks at ambient temperature (25–30 °C, ~82% RH), whereas uncoated tomatoes began deteriorating by the second week and were completely decayed by week fourresearchgate.net. In the aloe-coated batch, weight loss after 4 weeks was only ~13%, compared to ~46% in the uncoated batchresearchgate.net. The coated fruits also retained a brighter red color, indicating slower senescenceresearchgate.net. These results reinforce that aloe vera gel can greatly prolong the postharvest life of tomatoes even in warm conditions, by reducing desiccation and suppressing microbial growth. Aloe vera gel coatings have also been successfully used on other fruits like oranges, mangoes, and grapes in various countries, underscoring their broad applicabilityresearchgate.net. One notable study in India found that an aloe vera coating (20% gel) maintained higher tomato firmness and lower microbial counts over 14 days, compared to controlstandfonline.com.

The appeal of aloe vera gel as a coating in Nigeria lies in its natural availability and ease of preparation – farmers can extract gel from aloe leaves and apply it directly without sophisticated equipment. It is non-toxic and consumer-friendly, leaving no perceptible taste on the fruit. However, aloe gel coatings are somewhat delicate and can be sensitive to temperature and microbial contamination themselves (the gel can spoil if not handled properly). Thus, further work is needed on preserving or stabilizing aloe vera gel formulations for practical use (for example, adding a small amount of lemon juice or mild sanitizer to the gel to prolong its own shelf life). Nonetheless, the literature strongly indicates that aloe vera-based edible coatings are an effective, locally appropriate method to extend tomato shelf life in Nigeria's tropical environmentiiardjournals.orgresearchgate.net.

Chitosan-Based Edible Coatings

Chitosan is a polysaccharide obtained by deacetylating chitin, which is found in the shells of crustaceans and in fungal cell walls. It is a cationic biopolymer with well-documented antimicrobial and film-forming properties, making it a powerful agent for edible coatings. Chitosan coatings are generally colorless and form a semi-permeable film that can significantly inhibit fungal growth and reduce decay in fruits and vegetables. Although pure chitosan is effective, it can be combined with other substances (like organic acids, plant extracts, or starches) to enhance its performance. In Nigeria, chitosan could be produced from shrimp or crab shell waste (for example, from Lagos State's seafood processing); indeed, research has shown Nigerian shrimp shells to be a good source of high-quality chitosanresearchgate.net. Several studies highlight the benefits of chitosan-based coatings for tomatoes, including work done by Nigerian scientists and in comparable climates.

A recent Nigerian study by Ossamulu et al. (2023) evaluated a composite edible coating made of chitosan and cassava starch on tomatoes and eggplantsfood.actapol.net. The fruits were dip-coated in a chitosan-starch solution and stored at ambient temperature. The coated tomatoes remained visibly fresh and unspoiled for 12 days, whereas uncoated tomatoes deteriorated much soonerfood.actapol.net. Moreover, the coating helped preserve nutritional quality: after the storage period, coated tomatoes had significantly smaller losses in protein, fiber, and carbohydrate content compared to uncoated fruitsfood.actapol.net. The decline in ascorbic acid (vitamin C) and beta-carotene was also much less in coated tomatoes versus controlsfood.actapol.net. These findings suggest that the chitosan-starch composite not only extends shelf life by preventing decay but also slows down oxidative nutrient degradation by providing a protective barrier. The authors conclude that edible chitosan–starch coatings could be instrumental in curbing fruit deterioration in Nigeria while retaining nutrient qualityfood.actapol.net. This is particularly relevant for a country where postharvest losses contribute to nutritional deficits.

Chitosan alone has also proven effective in extending tomato shelf life. Venkatachalam et al. (2024) incorporated cinnamon oil into a chitosan coating and applied it to tomatoes stored at ~25 °Cmdpi.com. They observed that chitosan-treated tomatoes could be stored for 14 days with acceptable quality, whereas uncoated tomatoes became non-marketable after only 6 days due to microbial spoilagemdpi.com. The chitosan-cinnamon oil coating significantly reduced weight loss (to ~4–5% over 14 days) and maintained firmness better than the controlmdpi.com. The antimicrobial effect of chitosan (enhanced by the cinnamon oil's natural antimicrobials) kept microbial counts on coated tomatoes below spoilage thresholds throughout the two-week periodmdpi.com. This demonstrates how chitosan can be combined with locally available plant extracts or essential oils to further strengthen coatings – an approach that could be explored in Nigeria using indigenous spices or herbs with antimicrobial properties. Indeed, the flexibility of chitosan to form composite coatings (with starch, oils, etc.) makes it a versatile tool; other studies have enriched chitosan coatings with natural extracts like mint, moringa, or citrus, achieving both shelf-life extension and active inhibition of pathogens on tomatoessciencedirect.compmc.ncbi.nlm.nih.gov.

It is noteworthy that chitosan-based coatings can even suppress serious postharvest diseases. For instance, coatings of chitosan with tiny amounts of antimicrobial plant compounds have been shown to reduce incidences of mold and soft rot in tomatoes during storagepmc.ncbi.nlm.nih.gov. This is an important benefit in Nigeria, where fungal rot (often caused by *Aspergillus*, *Rhizopus*, *Fusarium*, etc.) is a common cause of tomato spoilageajol.infoajol.info. By creating a hostile surface environment (chitosan can disrupt fungal cell membranes and bind bacterial spores), the coating protects the fruit. From a feasibility standpoint, chitosan might be the most costly of the three local materials, since it requires chemical processing of shells. However, small-scale production of chitosan in Nigeria is feasible and has been demonstrated in academic settingssciencedirect.com. The cost could potentially be offset by using chitosan in low concentrations (even 1% chitosan solutions have proven effective) or by integrating chitosan production into existing waste recycling streams (e.g., fisheries discards). In summary, chitosan-based edible coatings are a highly effective intervention for extending tomato shelf life and have shown success in both laboratory and real-world trials. Their antimicrobial action addresses a key mode of tomato spoilage in the Nigerian context, making them a valuable component of an integrated postharvest management strategy.

Other Edible Coating Approaches in Tropical Contexts

Beyond cassava starch, aloe vera, and chitosan, other locally sourced materials have also been tested as edible coatings for tomatoes in Nigeria and similar environments. Beeswax, a natural wax from honeycombs, has traditionally been used as a fruit coating (e.g., on oranges) and is edible when refined. Pectin, a plant-derived polysaccharide (commonly from fruit peels), can form gel-like coatings. A recent study by Obiaocha-Nwaogwugwu et al. (2024) in Nigeria formulated edible coatings using beeswax, lime juice, and pectin in various combinations to preserve tomatoes, okra, and eggplantsajol.infoajol.info. They found that a coating combining beeswax and pectin (without lime) was most effective, extending the shelf life of tomatoes by over 23 days compared to uncoated fruitajol.info. Even the least effective formulation (beeswax + lime + pectin) still extended tomato shelf life by about 7 days beyond the controlajol.info. All the coating treatments in that study helped reduce microbial loads on the produce and slowed quality degradation, demonstrating the promise of natural waxes and polysaccharides as coatings. Similarly, gum arabic (a tree exudate plentiful in the Sahel region) has been reported to act as an edible coating that enhances tomato shelf-life and qualitysciencedirect.com. These alternative coatings are mentioned to emphasize that a variety of bio-based materials – many of which are available in Nigeria – can confer shelf-life extension. The choice of coating may depend on specific context: for example, beeswax could be more water-repellent (good against moisture loss) while aloe vera is more breathable; pectin adds strength to films; plant oils or extracts can add antimicrobial potency.

In all cases, the literature consistently shows that edible coatings, regardless of composition, function by a few common mechanisms: reducing water loss (thus limiting shriveling and weight loss), creating a modified atmosphere (reducing oxygen exposure to slow respiration and delay ripening), and acting as carriers for antimicrobials to suppress decay organismsiiardjournals.orgmdpi.com. These mechanisms are highly relevant for tropical, open-market storage of tomatoes in Nigeria, where dehydration and microbial spoilage are rampant. However, it is also evident that one must tailor the coating to avoid adverse effects – as seen with overly thick aloe coatings potentially trapping too much moisture, or certain combinations being less effective. Thus, ongoing research is fine-tuning formulations to maximize benefits. The range of materials tested in Nigeria and similar climates is expanding, indicating a growing interest in edible coatings as a practical solution for postharvest loss reduction.

Methodology (Proposed Future Research)

While numerous lab-scale studies have demonstrated the efficacy of edible coatings on tomatoes, there is a need for applied research to bridge the gap between controlled experiments and real-world usage in Nigeria. This section outlines a proposed methodology for future research to evaluate and optimize edible coating application for tomatoes in the Nigerian context. The proposed study would involve both experimental trials and field assessments:

Materials and Coating Formulation: The coatings of interest will be derived from cassava starch, aloe vera gel, and chitosan – used individually and in combinations. Food-grade cassava starch can be obtained from local processors and dissolved in hot water to prepare a 3–4% starch solution, plasticized with ~1% glycerol for flexibility (following formulations like Adjouman et al., 2018researchgate.net). Aloe vera leaves will be harvested and peeled to extract fresh gel, which can be used as-is or diluted (e.g., 50% gel with water) to adjust viscosity. Chitosan (if not commercially available within Nigeria) can be prepared from shrimp shell waste using the standard deacetylation methodsciencedirect.com; the resulting chitosan will be dissolved in 1% acetic acid to make a 1–2% solution. For composite coatings, combinations such as starch–chitosan (e.g., 2% starch + 1% chitosan) and aloe–chitosan (aloe gel with 0.5% chitosan) will be tested, as these have shown synergistic effects in literature (e.g., aloe + chitosan coatings can delay tomato ripening up to 42 days under cool conditionssciencedirect.com). All coating solutions will be prepared using locally available additives: for instance, a small amount of lime juice or ascorbic acid could be added to aloe gel to prevent browning, and a drop of vegetable oil might be added to starch-based coatings to improve water resistanceresearchgate.net.

Experimental Design: The study will use freshly harvested, mature-green tomatoes from a Nigerian farm (ensuring uniform size and maturity). The tomatoes will be randomly assigned to treatment groups: (1) uncoated control, (2) cassava starch coating, (3) aloe vera gel coating, (4) chitosan coating, (5) starch + chitosan composite, (6) aloe + chitosan composite, and potentially (7) starch + aloe + chitosan if feasible. Coatings will be applied by dipping fruits in the respective solution and air-drying. Each group will consist of multiple replicates (e.g., 3 crates of ~20 tomatoes each) to simulate storage in bulk. The coated and uncoated tomatoes will be stored under typical ambient conditions that mimic Nigerian market storage: about 28–30 °C and 70–80% relative humidity, with open-air ventilation. The storage period will last up to 21 days (or until all fruits in a group spoil). Quality assessments will be made at regular intervals (e.g., 0, 7, 14, 21 days).

Data Collection: At each interval, the following parameters will be measured for each treatment: weight loss (% of initial weight), firmness (using a penetrometer), skin color (using a colorimeter to track red color development), total soluble solids (°Brix, as an indicator of ripening), titratable acidity and pH, and vitamin C content. Spoilage incidence will be recorded as the number of fruits showing visible decay or mold. Microbiological analysis will be performed by swabbing tomato surfaces and plating to count total viable bacteria and fungi (CFU per mL). These measurements follow standard postharvest evaluation methodsfood.actapol.netresearchgate.net. The nutrient retention (e.g., vitamin C level) in coated vs. uncoated fruit will be of particular interest to see if coatings slow down nutrient degradation, as noted by Ossamulu et al. (2023)food.actapol.net.

Extension to Field Trials: In addition to lab simulations, the methodology will include a field trial component. Here, smallholder tomato farmers or market traders in a region of Nigeria (e.g., Kano or Kaduna, which are major tomato-producing areas) will be engaged. They will be provided with one of the coating solutions (whichever proved most promising in lab tests) and trained to apply it to part of their tomato stock after harvest. The rest of their tomatoes will be untreated, serving as a control under real handling conditions. The storage outcomes (time until significant spoilage, percentage losses, saleable quality duration) will be monitored. This practical trial will help assess user-friendliness of the coating (how easily can farmers apply it, does it fit into their workflow) and real-world effectiveness in non-controlled environments.

Data Analysis: The experimental data will be analyzed using ANOVA to determine statistically significant differences between treatments for each quality parameter and shelf-life outcome. We expect, based on prior studies, that coated tomatoes will show significantly lower weight loss, slower softening, and fewer spoiled fruits over time compared to controlsiiardjournals.orgresearchgate.net. The field trial observations will be qualitative and economic: noting if the coating allows farmers to sell a higher portion of their crop and if the extra effort and cost of coating are justified by reduced losses or higher prices (for instance, if farmers can hold coated tomatoes longer to sell when prices rise). Feedback from participants will be collected to gauge any challenges in adoption (such as time required, any changes in tomato appearance or acceptance by buyers).

This combined laboratory and field methodology will provide a comprehensive evaluation of edible coating technology for tomatoes in Nigeria. By using locally sourced materials in the formulation and involving end-users in trials, the research will generate practical insights into scaling up edible coatings beyond the lab. The outcome should identify an optimal coating strategy (in terms of formula and application method) and generate guidelines for its use in Nigerian conditions. Furthermore, the methodology allows us to identify any shortcomings (e.g., if a coating underperforms under field conditions or if certain quality aspects are affected, such as taste or skin texture) which would inform further refinement.

Discussion

The studies reviewed in this paper collectively indicate that edible coatings made from cassava starch, aloe vera gel, and chitosan can substantially extend the shelf life of tomatoes in Nigeria's postharvest conditions. By reducing water loss and delaying microbial spoilage, these bio-based coatings tackle the primary causes of tomato deterioration in the absence of refrigeration. Implementing such coatings could transform the tomato supply chain in Nigeria by reducing the currently high postharvest losses (often exceeding

40–50%canr.msu.edu) and thus increasing the availability of tomatoes in the market. Moreover, these coatings are food-grade and environmentally friendly, aligning with the need for sustainable agricultural practices.

Technological Feasibility: From a materials standpoint, Nigeria is favorably positioned to produce these edible coatings. Cassava starch stands out as a feasible material since Nigeria is the world's largest cassava producercbn.gov.ng. Converting a small fraction of cassava harvest into starch for coatings would not strain supply and could add value to cassava processing industries. Aloe vera, while not a staple crop, can be cultivated with relatively low input and is already grown in Nigeria on a modest scale for cosmetics and herbal uses. It can be rapidly propagated if demand for aloe gel increases. Chitosan production requires more processing technology (chemical or biotechnological deacetylation of chitin). However, there are efforts to utilize crustacean shell waste in West Africa for chitosan, and small pilot facilities or partnerships with research institutes could produce chitosan at the quantities needed for coating trialssciencedirect.comresearchgate.net. Thus, none of the materials are fundamentally limiting – all can be locally sourced, which is a major advantage for scalability and cost containment. Additionally, simple equipment like buckets or tubs for dipping, drying racks, and possibly hand sprayers are the main hardware needs, which are accessible to most farming communities.

Scalability and Adoption Challenges: Despite the technical promise, moving edible coating technology from lab research to widespread use among Nigerian tomato farmers and traders involves several challenges. First, awareness and knowledge transfer are critical. Farmers and market vendors would need to be educated about how and why to use edible coatings. Many are currently unaware of such techniques; thus, extension services or pilot demonstration projects are necessary. Second, labor and time constraints must be considered. Coating fruits (by dipping or spraying) adds an extra step after harvest. For it to be adopted, this process must be simple, quick, and cost-effective. In smallholder contexts, family labor might be available to do coatings, but during peak harvest, the speed of sales is often prioritized. If a coating allows farmers to sell gradually over weeks instead of dumping produce in a few days, it could yield better income – however, the farmers need proof of that benefit to change their practices. Economic analyses should be done to show that the reduction in losses (or the ability to fetch higher prices by selling later) outweighs the cost of coating materials and labor.

Another challenge is consistency and quality control. Edible coatings must be applied uniformly to be effective; uneven coating could lead to mixed results (with partially coated fruit still spoiling quickly). Training and perhaps small-scale mechanization (like a manual spray system or a dunk tank) could help ensure consistency. Coating formulations may need to be adapted to local preferences as well – for example, ensuring that the coating does not leave any visible residue or off-taste on the tomato. Generally, starch and aloe coatings dry to an invisible film, and chitosan is also transparent, so consumer acceptance should be high, but this should be validated. In fact, one advantage is that these coatings are not perceptible to the end consumer; unlike some chemical preservatives, they do not require any warning or change in how the tomatoes are used (the coatings are edible and flavorless).

One potential limitation to address is the shelf life of the coating materials themselves. Aloe vera gel can degrade if not kept cool, and cassava starch solutions might ferment or thicken over time in tropical heat. Developing shelf-stable preparations (perhaps in powdered form for starch, or concentrated gel for aloe) could be important for practicality. For instance, cassava starch could be sold as a dry powder with instructions to mix with hot water and glycerol to make a coating solution on-site. Aloe could be processed into a stabilized gel or powder (there are commercial aloe powders used in the food industry). Chitosan solutions can be prepared as needed. Packaging and distributing these coating formulations might require local entrepreneurs or cooperatives stepping in – an opportunity for agribusiness development (e.g., a small startup making "tomato coating kits" with starch, glycerol, and instructions).

Policy and Market Considerations: Government and institutional support could play a role in scaling up edible coatings. For example, agricultural extension programs in Nigeria could incorporate postharvest handling training that includes demonstration of edible coating use. Policies that encourage value addition and postharvest loss reduction (such as grants or subsidies for postharvest technologies) would incentivize adoption. If successful, reducing tomato losses by even half could have a notable impact on domestic supply and prices, potentially stabilizing tomato availability year-round and reducing the need for imports of tomato paste or concentrates.

It is also worth noting that edible coatings can complement other traditional or low-cost methods of preservation. For instance, in Nigeria some farmers use evaporative coolers (pot-in-pot cooling) to store vegetables for a short periodcanr.msu.edu. Coating tomatoes before placing them in such coolers could yield an additive benefit – the cooler lowers temperature a bit, and the coating reduces moisture loss, together significantly slowing spoilage. Likewise, combining coatings with improved packaging (such as ventilated plastic crates instead of woven baskets that cause bruisingcanr.msu.edu) would address multiple facets of the problem. Thus, edible coatings should be viewed as one tool in an integrated postharvest management approach.

Research Gaps: Despite positive findings so far, several research gaps remain. Most studies have been short-term and at a small scale. There is a lack of long-term studies on how coatings might affect fruit that is subsequently processed (e.g., if coated tomatoes are later canned or made into puree, do the coatings have any effect on processing quality?). Another gap is in understanding the interaction of coatings with different tomato varieties. Nigeria has various tomato cultivars (some thicker-skinned, some very soft); their response to coatings could differ and should be tested. Importantly, field-level validation under different climatic conditions within Nigeria (humid south vs. arid north) is needed, as coating performance might vary with ambient humidity and temperature.

Furthermore, while the focus has been on extending raw fruit shelf life, an allied area of research is whether edible coatings can suppress pathogens like *Salmonella* or *E. coli* on tomato surfaces, thereby improving safety as well as shelf life. Chitosan is known to have antimicrobial activity against human pathogens, so coatings might contribute to safer produce – a hypothesis worth investigating. Finally, consumer studies to ensure that coated tomatoes are equally acceptable (in taste and appearance) will be necessary for market adoption. The current evidence suggests no noticeable differences, but consumer perception research would bolster confidence for commercial rollout.

In summary, edible coatings using cassava starch, aloe vera, and chitosan are a technically viable and locally appropriate innovation to extend tomato shelf life in Nigeria. They can mitigate the urgent issue of postharvest tomato losses by slowing down spoilage in a cost-effective manner. The discussion above highlights that beyond the science, practical considerations of educating users, developing supply chains for coating materials, and ensuring economic viability are crucial for success. With targeted efforts to address these challenges, what is now seen in experimental settings – tomatoes staying fresh weeks longer due to a simple edible coating – could very well become a commonplace reality in Nigeria's markets. This would represent a significant stride towards more sustainable and secure food systems in the region.

Conclusion

Postharvest loss reduction is a vital component of improving food security and agricultural profitability in Nigeria. Edible coating technology offers a promising solution to the specific problem of rapid tomato spoilage. This review has illustrated that coatings derived from locally available materials – namely cassava starch, aloe vera gel, and chitosan – can dramatically extend the shelf life of fresh tomatoes. By forming protective barriers, these edible coatings reduce moisture evaporation, delay ripening, and inhibit microbial decay, thereby keeping tomatoes in saleable condition far beyond their normal uncoated span. In experimental trials, cassava starch-based composite coatings have kept tomatoes in good quality for up to 28 daysresearchgate.net, aloe vera gel treatments have cut weight loss and decay by more than half over 2–3 weeksiiardjournals.org, and chitosan-enhanced coatings have preserved both the appearance and nutritional content of tomatoes during storagefood.actapol.netfood.actapol.net. Such outcomes point to the potential for transformative impact if these methods are adopted in practice.

The feasibility of implementing edible coatings in Nigeria is bolstered by the country's resource base: abundant cassava for starch, arid-friendly zones for cultivating aloe, and seafood processing byproducts for chitosan. Utilizing these resources not only adds value to local products but also reduces reliance on imported preservation chemicals. Nevertheless, moving from research to real-world adoption will require addressing practical challenges. Key among these is raising awareness and providing training to farmers, traders, and food handlers on how to apply coatings properly. Pilot programs and extension services should be mobilized to demonstrate the cost-benefit of edible coatings in reducing losses. Additionally, entrepreneurial opportunities exist to produce ready-to-use coating formulations (for example, a powdered cassava starch coating mix) that can be easily distributed in rural areas. Policymakers and research institutions in Nigeria would do well to support such innovations, as they align with national goals of reducing postharvest losses and improving agricultural sustainability.

In conclusion, edible coatings represent an effective, low-cost, and eco-friendly approach to extend tomato shelf life in Nigeria. By leveraging cassava starch, aloe vera, and chitosan, Nigeria can develop home-grown solutions to preserve its tomato harvest, ensuring that more of what is grown reaches consumers rather than going to waste. The existing studies provide a strong proof-of-concept, and with further research focused on field implementation and optimization, these coatings could become a standard practice in the Nigerian tomato industry. The benefit would be multifaceted – economic gains for farmers and traders, more stable tomato supply for consumers and processors, and a reduction in the environmental and resource costs associated with food waste. Realizing this promise will require interdisciplinary efforts bridging food science, engineering, economics, and extension education. The evidence to date is encouraging: edible coatings can keep Nigerian tomatoes fresher for longer, and thus hold significant promise for enhancing food security and livelihoods in the region.

References (APA)

1) Adia, M. N., Iko, W., Swande, P. I., & Tume, C. T. (2024). *Effect of Aloe Vera Gel on Shelf Life of Tomato Fruits Grown in Gboko Local Government Area of Benue State, Nigeria*. Research Journal of Food Science and Quality Control, 10(6), 12–19iiardjournals.orgiiardjournals.org. DOI: 10.56201/rjfsqc.v10.no6.2024.pg12.19
2) Adjouman, D. Y., Kouassi, K. N., & others. (2018). *Effect of Edible Coating based on Improved Cassava Starch on Post-Harvest Quality of Fresh Tomatoes (Solanum lycopersicum L.)*. International Journal of Nutritional Science and Food Technology, 4(1), 1–8researchgate.netresearchgate.net.
3) Obiaocha-Nwaogwugwu, C. N., Eruteya, O. C., & Ahaotu, I. (2024). *Shelf-Life Extension of Tomatoes (Solanum lycopersicum), Okra (Abelmoschus esculentus) and Eggplant (Solanum melongena) Using Edible Coating*. Scientia Africana, 23(2), 375–388ajol.infoajol.info.
4) Olorunsogo, S. (2023, June). *Effects of Aloe Vera Based Edible Coating on Shelf Life and Quality of Tomatoes*. [Conference presentation]. (Data available via ResearchGate)researchgate.netresearchgate.net.
5) Ossamulu, I. F., Akanya, H. O., Egwim, E. C., & Kabiru, A. Y. (2023). *Improvement of Shelf-Life and Nutrient Quality of Tomatoes and Eggplant Fruits Using Chitosan–Starch Composite Coat*. Acta Scientiarum Polonorum Technologia Alimentaria, 22(1), 43–55food.actapol.netfood.actapol.net. https://doi.org/10.17306/J.AFS.2023.1092
6) Venkatachalam, K., Lekjing, S., Noonim, P., & Charoenphun, N. (2024). *Extension of Quality and Shelf Life of Tomatoes Using Chitosan Coating Incorporated with Cinnamon Oil*. Foods, 13(7), 1000mdpi.com. https://doi.org/10.3390/foods13071000
7) canr.msu.eduFeed the Future Nigeria. (2019). *Reducing Postharvest Loss in Tomatoes* (Extension Pamphlet). Michigan State University & USAID.
8) cbn.gov.ngCentral Bank of Nigeria. (2020). *Cassava: Commodity Development Initiative (CDI) Fact Sheet*. Retrieved from CBN website: https://www.cbn.gov.ng/