# THE DUAL EFFECTS OF EDIBLE COATINGS FOR FRUIT PROTECTION AND ENVIRONMENTAL HEALTH

**Zinash A Belay, Gadija Mohamed**

Agri-Food Systems and Omics Laboratory, Postharvest and Agro-Processing Technologies, Agricultural Research Council (ARC) Infruitec-Nietvoorbij, South Africa

Belayz@arc.agric.za

## Background

In South Africa, postharvest losses of fresh fruit remains significantly high up to 20-50%. Conventional plastic packaging and chemical preservatives help extend shelf life but contribute to environmental pollution and potential health concerns. Rising consumer demand for fresh produce has driven the search for alternative preservation methods.

## Objective

To assess and understand how bio-based polymer coatings reduce postharvest loss and maintain the quality of fresh fruit.

## Methodology

Bio-polymer selection → Coating preparation → Fruit selection and coating → Fruit drying and storage → Quality evaluation, descriptive analysis

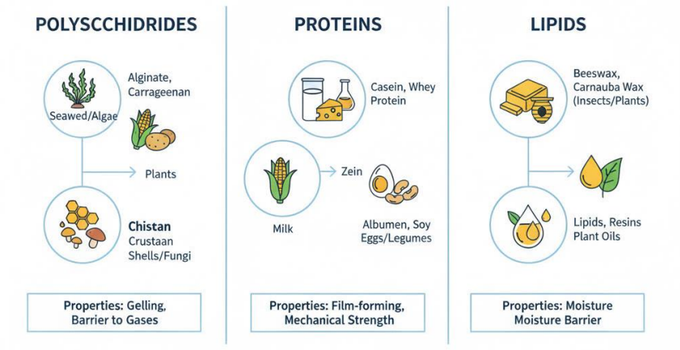



**Figure 1**. Schematic flow diagram for preparation and application of edible coatings

**Response parameters:** during postharvest storage, physicochemical quality (weight loss, firmness, TSS, TA, molecular response (protein) were analyzed following standard procedures.

## Main findings from selected study

### Visual representations

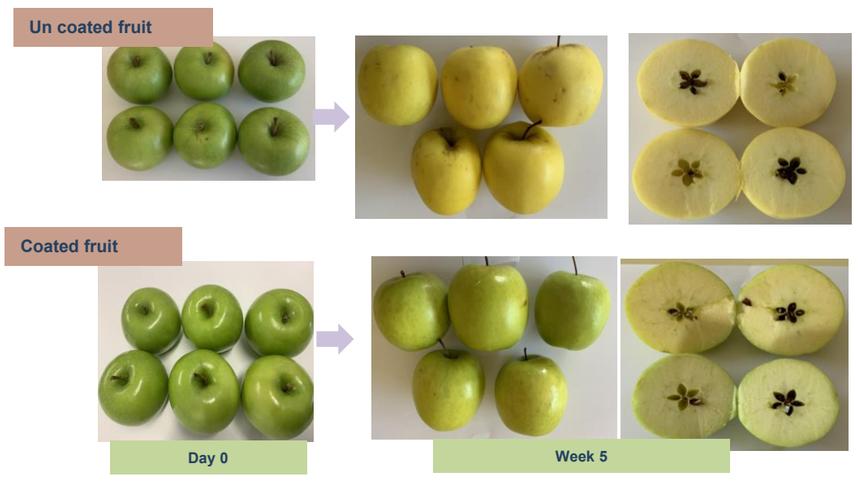


**Figure 2** .Visual appearance of 'sodium alginate coated and un-coated 'Granny Smith' apple during storage at 15 ˚C for 5 weeks

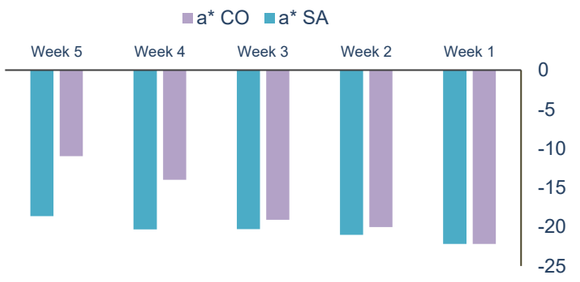


**Figure 3**. Apple fruit color parament (a*) change during storage

- Based on colorimetric analysis: uncoated apples exhibited a 50% loss in color, while those coated with sodium alginate (SA) showed only a 15% reduction.
- The $a*$ value increased (less negative) over time in both treatments, indicating a gradual loss of green color reflects normal ripening
- The slower increase in a* values in SA-coated fruits suggests that the sodium alginate coating formed a semi-permeable barrier, limiting oxygen exposure and thereby slowing oxidation, pigment degradation and quality loss.

**Table 1**. Postharvest lose quality indicators

| Quality indicators | Apple | | Treatment comparison |
|---|---|---|---|
| | Control (Co) loss magnitude | SA (Sodium alginate) loss magnitude | |
| Weight loss (wastage) | 5.45% (Total loss) | 2.08% (Total loss) | 3.37 % less loss. SA coating significantly reduced moisture evaporation, a primary form of mass loss. |
| Firmness (Texture loss) | 46.8% (Reduction) | 23.0% (Reduction) | 23.8 % less loss of firmness. SA coating effectively slowed down the softening process. |
| Titratable acidity (TA) (Flavor loss) | 17.5% (Reduction) | 1.8% (Reduction) | 16.7 % less acid consumption. SA coating better preserved the fruit's organic acids, retaining better quality and flavor. |
| TSS (Soluble solids change) | 5.6% (Increase) | 2.0% (Increase) | 3.6% lower magnitude of change. While both increased, the lower change magnitude in SA suggests slower metabolic stability. |

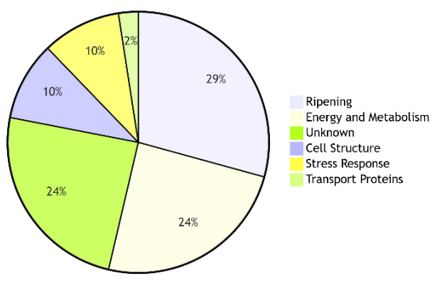


**Figure 4**. Protein distribution by functional category

- After 5 weeks, the largest functional group is ripening (29.3%), shows the fruit's developmental stage.
- Energy and metabolism pathways (24.4%), shows a robust metabolic activity, typical of active biological processes like fruit maturation. It provides essential precursors and ATP for ripening reactions
- Un coated samples were enriched in ripening-associated proteins, whereas coated samples showed higher abundance of proteins related to cell wall integrity and stress defense.

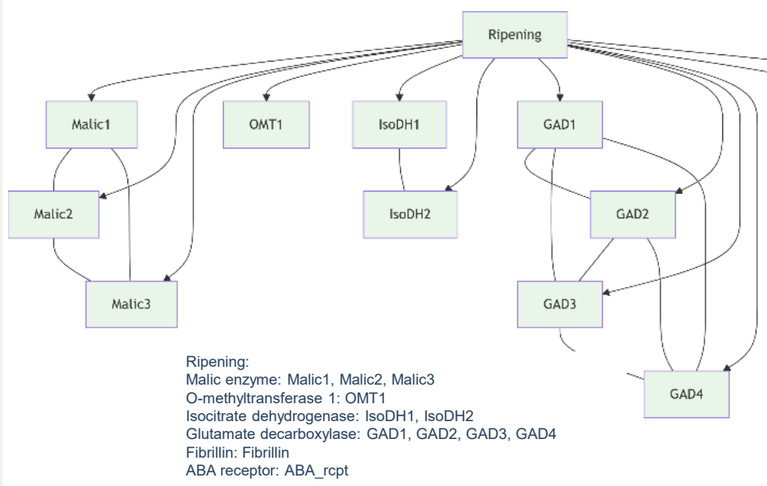


**Figure 5** .Ripening related proteins

- Cell wall–degrading enzymes (Pectate lyase, Endoglucanase) break down structural components, cause softening; inhibiting them preserves firmness.
- Multiple GAD isoforms produce GABA, a metabolite linked to stress and senescence during ripening

Hormonal signaling: ABA receptor regulates ripening; its inhibition slows the ripening process.

## Concussion

- This study demonstrated that sodium alginate coating effectively reduces postharvest loss by delaying ripening and senescence.
- The coating also preserves key quality attributes and extends the marketable shelf life of the fruit.
- Proteomic analysis provides a molecular roadmap and exhibited key regulatory proteins and their functional roles in delayed ripening of coated apples and accelerated ripening of uncoated ones. This approach identifies precise targets for strategies to minimize postharvest quality loss.

ARC • LNR
Excellence in Research and Development

Agri-Food Systems & Omics

Regional Workshop on Food Loss and Waste in Sub-Saharan Africa
October 27-29, 2025
Pretoria (Republic of South Africa)