In the age of food security and wastage concerns coupled with consumer demands of fresh and minimally processed foods, shelf life emerges as a key concern for nations and enterprises. This challenge is further complicated for import dependent food economies as the shelf-life clock for a perishable food product such as Vegetables, Fruits and Meats, starts a countdown the moment the food is extracted and shipped from the producer to the destination. The GCC (Gulf Cooperation Council) region imports nearly 90% of all its perishable food requirements but recent efforts in food self-sufficiency are expected to bolster the domestic production. With this pretext, the preservation of perishable foods is a crucial challenge to ease the import burden and enhance longevity of the perishable foods supply chain in the GCC.

Shelf-life concerns are nothing new and have existed as an active facet of the Agri-Food value chain since the 1900s with the evolution of food export value chain. Shelf-life extension has seen recent interest and innovation owing to the pandemic disruption and countries globally have advanced the efforts to tackle Food Wastage that costs the global economy over USD 1 Trillion every year with more than 1.3 Billion Tons of food wasted every year due to improper storage and/or logistics arrangements. Besides the pressure on the Food Security front, improper storage and reduced shelf life also dents the profits for importers and retailers who are forced to incorporate discounts into their offerings to make up for slow moving produce.

While packaging and processing have been the traditional choice for food preservation and shelf life extension, the Food Industry has also started incorporating Big Data and Artificial Intelligence to predict and pre-empt the food consumption to eventually develop sustainable and waste reduction focused sourcing strategies.

Effectively, shelf life extension challenges can be identified as follows

- Enzyme Activity
- Temperature Variation
- Humidity Variation
- Microbial Contamination
- Physical Damage etc.

To overcome these challenges, a multifaceted approach has become mainstream including

- Packaging Augmentation
- Pre-Treatment
- Cold Chain Improvement
- Temperature and Humidity Maintenance
- Individual Packaging
- Smart Labelling
    - Slow Ripening Variant Development
    - Anti-Microbial Treatments.

While the above approaches have been able to provide modest, inconsistent and intermittent results globally, they also need to be supported with larger incorporation of recent technological advances to achieve better results through innovation. An outline of possible and feasible approaches can be:

1. Big Data driven Demand Analysis: Importers and Processing companies have started deep diving into demand data to understand and predict demand drivers and demand patterns. These insights can be utilised to create an information driven system that reduces waste at source and creates functional value chains utilising Root to Tip and Hoof to Head Processing.
2. In silico Biology Platforms: R&D Functions in F&V processing companies are exploring the utilisation of Predictive Biology on synthetic biology systems to model the ripening and best sensorial behaviour of raw materials and finished goods. Enzyme maturity, Delayed Ripening, Flavour Enhancement and Gas Exchange technologies are gaining prominence in food processing sector to Augment or Analyze Food Ripening.
3. Active & Smart Packaging: Often quoted as the next frontier in packaging innovation, these packaging solutions go one step beyond the traditional separation and passive preservation to employ directly interactive technologies such as Enzyme Scavenging and CO2 Emission to actively prevent physiological and chemical reactions from occurring thereby extending the shelf life.

Due to the inherent diversity of the perishable product value chain, its crucial to acknowledge that there is no one solution fits all approach. The purpose, duration and feasibility of shelf-life extension will always be variable and hence requires a detailed Value Chain Audit to understand and upgrade the technologies that may be suitable to your requirements. The provided matrix encapsulates the various approaches and applicability in the spectrum of shelf-life Extension.

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