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Smart interventions in floriculture for enhanced shelf-life and value-addition

The use of advanced post-harvest treatments, and sustainable packaging solutions has revolutionized flower preservation and value-addition. These smart interventions focus on reducing spoilage, maintaining aesthetic quality, and optimizing resource use. Additionally, value-addition techniques such as the development of bio-preservatives, decorative enhancements, and eco-friendly packaging solutions further contribute to increasing market appeal and sustainability. The integration of these technologies not only improves the profitability of the floriculture sector but also aligns with global trends in sustainability and consumer preferences for eco-friendly products. This article highlights the crucial role of innovation in driving the future of floriculture towards a more efficient, profitable, and sustainable direction.

FLORICULTURE, the cultivation of flowering and ornamental plants, has evolved into a thriving industry contributing significantly to the global economy. The beauty and charm of flowers, however, is ephemeral. Once harvested, they begin to lose freshness, aesthetic appeal, and fragrance, which diminishes their market value. Enhancing the shelf-life of cut flowers and adding value to floricultural products is, therefore, a critical focus for stakeholders in this sector, including producers, retailers, and researchers. The global cut flower market was valued at US$ 17611 million (in 2020) is expected to reach US$ 26677.82 million by the end of 2027. The Indian floriculture market worth INR 187.6 billion (in 2020) is expected to reach a value of INR 546.4 billion by 2026.

The important floricultural crops in the international flower trade are rose, carnation, chrysanthemum, gerbera, gladious, gypsophila, liastris, bird of paradise, orchids, anthurium, tulip, lilies, etc. All the flowers and ornamentals being the most perishable commodities needs special care during harvesting, handling, storage and transport. The losses can be both, quantitative as well as qualitative, which result in loss in terms of monetary value. Due to perishable nature of flowers, there is huge post-harvest loss ranging from 30-50%. Qualitative losses like consumer acceptability of fresh produce are much more difficult to assess than are quantitative losses. Quantitative losses occur during the entire market chain in view of lack of improper post-harvest handling. Smart interventions, involving advanced techniques in maintaining shelf-life and value-addition, can help prolong the vase life of flowers, reduce waste, and create value-added products. This article details various smart interventions in floriculture, focusing on their role in enhancing shelf-life and adding value to products, ultimately boosting the economic viability of the sector.

Advances in enhancing the shelf-life of flower crops

The post-harvest life of flowers is notoriously short, leading to significant losses and waste. In response, scientists, horticulturists, and the floral industry have developed innovative techniques to extend the shelf-life of flower crops, ensuring longer-lasting beauty and value. Below are the key advances in enhancing the shelf-life of flowers, from different post-harvest strategies.

Chemical treatments and preservatives

Chemical agents have long been used to extend the shelf life of flowers, but recent innovations have made treatments more effective and eco-friendlier. Some notable advances include:

Ethylene inhibitors: Ethylene gas is a plant hormone that accelerates aging in flowers. Inhibitors like 1-methylcyclopropene (1-MCP) are widely used to block ethylene receptors, slowing down the senescence process. These chemicals can now be applied in safer, more controlled doses, minimizing environmental impact.

Antimicrobial solutions: One of the primary causes of flower decay is bacterial growth in vase water. New-generation antimicrobial agents, such as chlorine dioxide and natural plant extracts, are being used to purify water and reduce microbial activity without harming the environment.

Modified atmospheric packaging: Modified atmosphere packaging (MAP) plays a crucial role in preserving the quality of cut flowers after harvest by slowing down physiological changes. In addition, the increased concentration of CO_2 inside the packaging greatly reduces respiration and ethylene production,

leading to a significant decrease in energy output. The packaging also allows for the removal of harmful gases while enabling control over oxygen and carbon dioxide levels. Modified atmosphere packaging (MAP) efficiently maintains the quality of fresh produce by lowering respiration rates, reducing material consumption, minimizing CO_2 production, decreasing oxygen use, and limiting heat generation. Furthermore, MAP stabilization for cut flowers can be achieved by using plastic materials with different levels of permeability to CO_2 and O_2. However, the floral response during storage is greatly affected by the final concentrations of CO_2 and O_2 inside the packaging, along with maintaining water balance in the flower stems.

Product developed

Freshness keeper paper for cut flowers- A paradigm shift

Paper-based freshness keeper, a patented technology developed by CSIR-CFTRI is a simple, chemical-free design to keep cut rose flowers fresh during transport and storage, without disturbing the protocol of cut rose flowers. Freshness keeper paper can be wrapped with direct contact with rose flower petals that helps to enhance fresh-cut rose flower quality and shelf-life by 2-fold. Increase in shelf-life impacts transportation and cold supply chain, helping export.

Freshness keeper paper for cut flowers

Advances in value-addition of flower crops

The global floriculture industry is continuously evolving, driven by consumer demand for innovation and sustainability. Value-addition in flower crops involves enhancing their appeal, marketability, and usability beyond their basic ornamental purpose. This not only increases the economic value of flowers but also creates new opportunities for growers, traders, and consumers. Recent advancements in technology, processing techniques, and creative applications have significantly expanded the possibilities for value addition in flower crops.

Dry flower technology

Drying flowers is one of the oldest and most popular methods of value-addition. Since the dry flower industry is growing very rapidly and at present contributes about 70% of the earning of the total floriculture produce. In our country dry flower industry comprises of dehydrated flowers, foliage, fruits and seeds. Advances in drying technologies have greatly improved the quality of dried flowers, preserving their colour, shape, and texture for extended periods. Modern drying techniques such as freeze-drying, microwave drying, and silica gel drying allow for precise control over the process, reducing the

Dry flower technology

Incense sticks from floral waste

risk of colour fading and deformation. In which CSIR-NBRI being a pioneer in the development of the dry flower technology under DST-DSIR funded project, has developed expertise with different ornamental plants on this line.

Herbal gulal from floral temple waste

In India, the use of colour at various events dates back as far as your history. According to published accounts, Holi has traditionally been coloured with natural dye made from keshu, palash, or *tesu* flowers as well as turmeric.

CSIR-NBRI has developed the process technology for the manufacturing of Herbal *Gulal* (dry colour powder) composition utilising natural dyes and natural materials in order to give a safe alternative to synthetic-based dry colours.

Herbal gulal from floral temple waste

Incense sticks

The ecology suffers when incense is burned and flowers are offered to God. During the religious festivals, incense is burned in homes and temples. Particulate particles (PM), gas by-products, and several other chemical compounds can all be present in incense smoke (fumes). The use of flower wastes in the creation of herbal incense sticks has been reported. Under a Project named Mission Sakshama initiated by CSIR-CIMAP, Lucknow aimed at utilizing waste flowers, the floral waste is converted to Incense sticks. On an average 1,500 agarbattis (incense) can be made from one kg raw material (filling material as flower powder and binding material) through this technology.

Epoxy value added products

Soap

Flowers like *genda* are used to make incense sticks.

Herbal hand wash and soap (floral-based)

The salient features are pH-balancing formula for healthy skin, kills germs (bacteria and fungi) effectively by inducing oxidative stress, no skin irritation and burning effects and biodegradable.

Epoxy value added resins

Resin encapsulation techniques refer to the process of embedding dry flowers in resin. Metal, glass, wood, stone, and polymers all use epoxy resins as adhesives. Dry flowers can be used to make a variety of value-added goods that can be translucent or coloured with epoxy resin. This is a process in which dry flowers are permanently trapped in resin, displaying eternal beauty forever. At the CSIR-National Botanical Research Institute in Lucknow, researchers are using epoxy resin to dehydrate several annual and perennial blooms.

Beverages

The flower extract containing high levels of anthocyanin pigment has the potential to be further processed into healthy functional drinks. The addition of natural flavour to the production process is expected to improve the sensory and functional aspects of this rose extract-based drink with some added natural flavours.

CONCLUSION

The article highlights the transformative potential of advanced technologies and innovative practices in the floriculture industry. Through the adoption of smart interventions–ranging from precision agriculture and improvements to post-harvest treatments and sustainable packaging–growers can significantly extend the shelf-life of flower crops and increase their market value. These interventions not only improve the quality and longevity of flowers but also contribute to reducing waste, minimizing environmental impacts, and meeting the evolving demands of consumers. As floriculture continues to embrace cutting-edge approaches, the integration of these technologies will play a pivotal role in shaping the future of the industry, enhancing both economic outcomes and sustainability.

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