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Efficient Strategies for Strawberry (*Fragaria x ananassa* Duchesne) Storage on Farms

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ABSTRACT
Strawberry (Fragaria x ananassa Duchesne) is fruit that's enjoyed by many people worldwide. However, like most fruit varieties, this fruit also faces challenges regarding its storage. Although this is the case, strawberry storage protocols are well established. Nevertheless, on farms, the storage of this culinary fruit is important so that the challenges to obtain good quality fruits are avoided at some costs. Like we have seen with pineapple fruits, storage protocols are essential and ought to be effective so that the produce obtained is superior in quality, irrespective of the variety being transported. In this article, efficient storage strategies of strawberries on farms will be discussed as this is considered to be an essential requirement for strawberries having an extended shelf life, as well as a process for producing superior produce to consumers.

KEYWORDS: *Fragria, Delicate, Storage, Harvest, Lifespan, Mold, Diseases, Packaging, Humidy Control, Hydrocooling.*

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Strawberries are a favourite fruit in a variety of culinary creations, particularly because they are juicy in texture, have a sweet aroma as well as possess a vibrant colour (Kawata et al., 2016; Li and Kader, 1989; Singh, 2023). However, on farms, one of the major problems is that they are delicate and highly perishable, and as a result, this poses several challenges for farmers and distributors (read Sacks and Shaw, 1993). Therefore, proper storage techniques are used to maintain the quality and freshness of strawberries, after they are harvested (Park et al., 2012). These storage conditions are essential for the strawberries to have an impactful taste, texture and nutritional value (Sacks and Shaw, 1993; Park et al., 2012). Strawberries have a short life span, and this is a great challenge for growers and consumers, particularly because they are a seasonal delight (Matsumoto et al., 2008). After harvesting of strawberries, there is a period which is crucial for determining the final quality of the strawberries (Matsumoto et al., 2008). The primary purpose of storage protocols is to prevent decay, the loss of nutients, and most importantly, the flavour, texture and visual appeal (Ozkaya et al., 2009).

In order to preserve the shelf-life of the fruit, researchers often utilise cool storage protocols (Singh, 2017). After harvest, farmers will tend to subject the strawberries to rapid cooling (Sacks and Shaw, 1993). This rapid cooling process is known to slow down the process of ripening (read Forestry paper- Singh, 2017). Usually, at temperatures between 32°F to 36°F (0°C to 2.2°C), a farmer will keep the strawberry harvests (Laguerre *et al*., 2002; Park *et al*., 2012; Rodriguez-Bermejo *et al*., 2007). This is the

temperature of refrigeration rooms or coolers which house the strawberries (Rodriguez-Bermejo *et al*., 2007). This low temperature has several advantages to the storage of strawberries (Singh, 2016; Sacks and Shaw, 1993). Two advantages are a reduced respiration rate and the inhibition of spoilage microorganism growth, which results in the fruits having a longer-lasting freshness to consumers (Eaks and Morris, 1956).

Unlike the method above, in some situations farmers may adjust the composition of gases surrounding the fruit in packages (read Chandra *et al*., 2015). This is called modifying the atmosphere packaging. This is essential to retard the deterioration of the strawberries (Chandra *et al*, 2015; Singh, 2016, Singh, 2017; Singh, 2017). In order to extend the self-life of these fruit, a key feature using this technique, is the controlled oxygen and carbon dioxide levels (Chandra *et al*, 2015; Ikegaya *et al*., 2020). The controlling of these 2 gases has been known to extend fruit shelf-life, which is essential to manufacturing houses (Singh, 2023). Thefore, it can be deduced that modified atmosphere packaging contributes more significantly to better storage outcomes by delaying the natural ripening of the fruit as well as suppressing mold growth (Ikegaya *et al*., 2020).

Strawberry plants require adequate ventiliation, so that moisture doesn't destroy the fruit (Singh, 2023). Hence, ventilation and humidy control is essential to prevent mold growth and decay of the fruit (Singh, 2023). An area where there is proper ventilation is advantageous for strawberry storage, because of the expulsion of humidity (read Ozkaya *et al*., 2009; Park *et al*., 2012). However, there needs to be an adequate balance between ventilation and humidy control, since in areas where there is excess airflow it must be noted that there could be moisture loss, leading to shriveled strawberry fruits (Singh, 2017; Sacks and Shaw, 1993). In addition, using effective humidity control systems may also prevent the fruit from drying (Wang *et al*., 1997).

A post-harvest technique used for storage of strawberries is hydrocooling (Singh, 2023). This technique involves immersing the strawberries in cold water. This technique removes field heat, and also cools the fruit quickly so that excessive heat is removed (read Park *et al*., 2012). Excessive heat imbued in the fruit is not good, particularly since over-heating can promote fruit spoilage and microbial growth (Whiteman, 1977; Wang *et al*., 1997). Therefore, hydrocooling allows the strawberries to maintain their natural flavour and texture (Singh, 2023).

During harvesting, packing and transportation of the fruit, handing of the fruit is of pivitol importance (Jung *et al*., 2018). The fruit needs to be handled with utmost care in order to prevent bruising and physical damage of the fruit, as damaged fruits are more susceptible to microbial infection and spoilage (Wang *et al*., 1997). The packaging used during the transport process should at all times protect the fruit from physical harm, while, at the same time, allowing for adequate ventilation in order to prevent excess moisture accumulation (Singh, 2023).

Quality checking of the fruit is important to prevent decaying of fresher fruit produce. Therefore, regular quality checks are essential so that damaged and overripe fruits can be removed from the storage batch (Wang *et al*, 1997. Identifying problematic fruits and taking the appropriate corrective measures can help improve storage procedures (Ikegaya *et al*., 2020). Inventory management procedures are essential to ensure that older batches strawberries are sold prior to fresher ones being sold. This procedure prevents the accumulation of older strawberries, which compromise newer strawberries, and enhances the overall quality of strawberry produce available for distribution (Singh, 2023). Therefore, one can adopt a "one in, one out" approach to strawberry stock inventory system (Singh, 2023).

In conclusion, in the balance between natures produce and consumer satification, one can say that effective storage practices are a crucial link in order to maximise the economic produce of the fruit. In order for farmers to het fresh, delicious and visually attractive fruits, the above storage practices are integral to maintaining fruit quality, prolonged sheld-life and minimizing post-harvest losses.

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