RECENT ADVANCES IN POST HARVEST PRACTICES IN LITCHI

Abstract

Litchi (Litchi chinensis) is a tropical and sub-tropical fruit highly valued for its unique flavor, nutritional richness, and medicinal properties. Post-harvest practices play a crucial role in maintaining the fruit's quality, extending its shelf life, and enhancing market competitiveness. This abstract provides a concise overview of recent advances in post-harvest technologies and practices applied to litchi.

In the field of horticulture numerous types of fruits are cultivated such as litchi fruits, are typically removed using 'handpicking' techniques from various positions on the individual fruit trees. The fact that large-scale fruit harvesting remains both ineffective and costly is widely recognized. In order to reduce physiological and biochemical changes in litchi fruit, recent research has concentrated on improving post-harvest handling, storage, and transportation techniques. By regulating respiration rates, minimizing weight loss, and postponing senescence, advances in modified atmosphere packaging (MAP), controlled atmosphere storage (CAS), and low-temperature storage have demonstrated encouraging outcomes in maintaining litchi quality. In India, litchi is among the most cherished fruits. Economic value of litchi harvesting techniques has also been covered in this review. Many litchi- based goods have been described, including litchi juice, canned litchi, litchi RTS, litchi honey, litchi wine, and healthful litchi cocktails. Litchi handling methods, storage options, and export prospects have all been covered. Reducing postharvest litchi

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losses effectively emphasizes the integration of pre- harvest cultivation, postharvest handling processes, cold chain management, and the creation of value-added products. In this review, we have focused on a few of the goods that have been and still need to be commercialised.

Keywords: Clipping,Shaking, Wine, Canned Litchi, Litchi Honey

I. INTRODUCTION

A tree in the soapberry family (Sapindaceae) known as the lychee (Order: Sapindales; Family: Sapindaceae; Genus: Litchi) often spelled litchi or lychee,is an important subtropical fruit crop(Huang et al., 2016), is farmed for its tasty fruit. For generations, the Cantonese people have held a deep affection for lychee fruit, a fruit that originates from Southeast Asia. It is a sweet and juicy fruit that is native to China. It has a red, bumpy outer layer that is peeled to reveal a white, fleshy fruit inside. The flesh of the litchi fruit is sweet and slightly tangy, and its flavour is often described as a cross between a grape and a pear. Litchi fruits are a good source of vitamins, antioxidants, and other nutrients, and they are commonly eaten fresh or used in various culinary dishes, including fruit salads, smoothes, and desserts. The fruit is believed to have originated in Southern China and Northern Vietnam, where it has been cultivated for a long time (Panwar et al, Menzel et al.,2018). It is often referred to as the Queen of Fruits because of its enticing colour (deep pink or red) and flavourful, sweet, and juicy aril (Sinha, 2015).

People of Malayan descent have recorded the cultivation of litchi as early as 1500 B.C., and it has been flourishing in Southern Guangdong Province of China for a very long time. Litchi cultivation was brought to India from Thailand in 1798 and has since taken root in the humid subtropical regions of the nation, particularly along the foothills of the Himalayas. Its cultivation is predominant in China, India, Thailand, Taiwan, and the United States on a global scale. Conversely, in the Southern Hemisphere, it thrives in regions like South Africa, Australia, and Madagascar (Menzelet al., 1993; Menzelet al, 1988; Menzel, 2001).

While fruit can also be preserved through canning or drying methods, it is typically enjoyed in its fresh state. The dried fruit pulp offers a tart and intensely sweet taste, while the fresh pulp carries a aromatic and slightly musky flavour. The fruit features a rough pericarp around the tasty, luscious, succulent aril with a seed in the middle. The pericarp browning, postharvest degradation, and slight racking are a few of the major factors affecting the quality of lychee during storage and transit, which is why growers are still interested in its commercialization (Manoj Kumar, 2017) .

II. ECONOMIC IMPORTANCE

In India, approximately 594,000 metric tonnes of litchi are cultivated, with Bihar contributing 45% of this total (according to NHB, 2015). Among the key litchi-producing regions in Bihar, the Muzaffarpur district stands out. In Bihar, a significant portion of the litchi crop is sent to the wholesale market in Delhi, from where it is distributed to retailers. The supply chain for established markets like Delhi involves farmers, wholesalers, retailers, and consumers. In contrast, local markets like Muzaffarpur follow a different pattern, with litchi moving from harvesters or pre-harvest contractors directly to consumers, bypassing the wholesale stage. It's worth noting that a majority of litchi fruits are transported to distant markets using non-refrigerated trucks.(Shibangi Shimpy, 2022)The seeds are fleshy, sweet arils are delectable; they can be eaten fresh or canned. From China are exported dried fruits and litchi nuts. Like raisins, the flesh of dried litchis is consumed. Chinese people like to use

the dried flesh for sugar in their tea as a sweetener. Litchis are also occasionally seasoned, pickled, or turned into sauce, preserves, or wine. In neuralgic conditions, litchi seeds are used as an anaesthetic. When consumed in moderation, the litchi is supposed to reduce coughing and to be effective against tumours and gland enlargements. To treat diarrhoea and smallpox outbreaks, a fruit peel tea is consumed. Due to their astringency, the seeds are pulverised and used medicinally in India(Pandey, 2012).

Litchi is considered to be economically important because of its Market demand as it is a highly sought-after fruit due to its unique taste, aroma, and texture. This demand has made it a popular choice for both fresh fruit and processed food industries, such as canned fruits, juices, and desserts. Litchi is one of the major horticultural crops exported from developing countries, such as India and Thailand, to developed countries, including the United States and Europe. This has helped to generate significant foreign exchange earnings for these countries and its cultivation provides employment opportunities in various stages of production, such as planting, pruning, harvesting, and processing. Litchi is a rich source of vitamins and minerals, such as vitamin C, potassium, magnesium and Phytonutrient flavonoids and essential minerals such as manganese, magnesium, copper, iron, and foliate, among others, are present in litchi fruit, although their levels may differ depending on the specific litchi variety (Prakash , 2017; Reyes , 2016). This has made it a popular choice among health-conscious consumers, and has contributed to its growing demand.

Table 1: Indian Production of LITCHI Production (000tonnes)

Sl No.	**State**	**Production**	**Share(%)**
1	Bihar	308.06	42.55
2	West Bengal	71.76	9.91
3	Jharkhand	64.42	8.90
4	Assam	60.58	8.37
5	Chattisgarh	58.12	8.03
6	Punjab	51.50	7.11
7	Uttar Pradesh	39.37	5.44
8	Uttarakhand	24.72	3.41
9	Odisha	24.15	3.34
10	Himachal Pradesh	6.18	0.85
11	Haryana	3.51	0.48
12	Nagaland	3.35	0.46
13	Tripura	3.22	0.44
14	Mizoram	1.85	0.26
15	Jammu & Kashmir	1.74	0.24
16	Sikkim	0.97	0.13
17	Manipur	0.33	0.05
18	Arunachal Pradesh	0.09	0.01
19	Karnataka	0.06	0.01
	Total	**723.98**	

Source: National Horticulture Board (NHB) 2021-22 1st Adv. Estimate

III. MATURITY INDICES

Because the fruit is non-climacteric and its maturation essentially halts upon harvesting, picking it prematurely will result in a negative impact on crucial aspects of fruit marketing and flavour, specifically, its colour and sugar/acidity balance. Harvesting is deemed appropriate when the pericarp becomes uniformly red, typically when the orange hue has entirely or nearly vanished, unless it's a variety that yields yellow or green fruit, and when the protuberances on the fruit have become smoother..The colour of the litchi fruit changes from green to red as it ripens. A fully ripe litchi should be deep red in colour. As litchi matures, the skin becomes less firm and the flesh becomes softer. The aroma of fruit becomes more pronounced as it ripens. The sugar content increases as it ripens and a fully ripe litchi should have high sugar content, usually around 15-20% by weight. The acidity also decreases as it ripens i.e. usually around pH 3.5-4.5. When ripened come off easily from the stem with a gentle twist. If it does not, it is not yet fully ripe. It is important to note that the maturity indices for lychee can vary depending on the variety and growing conditions. Therefore, it is recommended to use a combination of the above indices to accurately determine the stage of ripeness of litchi fruit(Wu, 2000).

IV. HARVESTING

After being picked, exposing litchi fruits to the light and air can significantly increase water loss. It is usually harvested when it reaches full maturity, which is indicated by the deep red colour, soft texture, sweet aroma, and high sugar content of the fruit. Overripe fruit will have a lower quality and shorter storage life. The fruit should be gently twisted to separate it from the stem, taking care not to damage the skin or the fruit itself. Fruits that have been harvested can therefore be stored in a cooler area of the orchard or in a temporary thatched house to allow for cooling. The fruit can be covered with a tarpaulin, but it needs to be kept clean to avoid the growth of diseases. In situations characterized by high temperatures and low humidity, applying a fine water mist to the fruit could potentially assist in maintaining the quality of the fruit. The best fruit should be set aside for fresh consumption, while lower-quality fruit can be used for processing into juice or other products (Devi, 2022)

Fruits that have scars, cracks, discoloration, or other damage can be separated from the rest of the harvest and taken out of the field later. In a pack house, precise processes include washing and grading in accordance with important factors like size, colour, etc. Lastly it is packed carefully to protect it from damage during transportation and storage. Suitable packaging materials include plastic trays, baskets, or boxes, covered with a perforated plastic film to allow for ventilation.(Costa, 2014)

V. METHODS OF HARVESTING

Harvesting of litchi fruit is an important process that affects the quality and storage life of the fruit. Proper harvesting methods are crucial for maintaining the fruit's freshness, taste, and texture. Common methods that are usually adopted are **Hand picking** which is the most common method of harvesting litchi where the fruit is gently twisted to separate it from the stem, taking care not to damage the skin or the fruit itself. In **Clipping**, a pair of clipping shears is used to cut the stem of the fruit, separating it from the tree and this method is less commonly used because it can cause more damage to the fruit. **Shaking** method involves

shaking the tree to cause the fruit to fall off. This method is less common because it can result in damage to the fruit and is only used in certain regions where the fruit is abundant. Mechanical harvesting is adopted in some countries, such as China and India. In this method, a machine is used to shake the tree and collect the fruit, reducing the time and labour required for hand picking. Regardless of the method used, it is important to grade the harvested fruit and separate it into different categories based on size, colour, and quality. The best fruit should be set aside for fresh consumption, while lower-quality fruit can be used for processing into juice or other products. By following proper harvesting methods, we can ensure that your litchi crop is harvested properly and that the fruit is of high quality and has a long storage life (Costa, 2014).

1. **Sorting:** The sorting procedure removes fruits that are overly ripe, damaged, diseased, sliced, too small, or too large. It also categorizes the produce based on factors like color, level of maturity, and ripeness. Sorting is done based on size with larger fruit being considered of higher quality, shape of the fruit is also considered with round, plump fruit being considered of higher quality than misshapen or irregular fruit. The color of the fruit is an important factor in sorting, with red, fully mature fruit being considered of higher quality than green or yellow fruit. Quality is an important factor in sorting, with fruit that is free from bruises, cuts, and other damage being considered of higher quality(Manoj Kumar, 2017)

   A preliminary sorting of produce should remove unmarketable pieces and foreign matter (plant debris, soil and stones). By removing faulty fruit during sorting, a certain fruit quality is preserved. At this point, all the fruits must be carefully examined in well-lit conditions. To ensure that defective samples are not included in the packaging, it is essential to thoroughly inspect the entire surface of the fruit. If damage reaches the aril, decay can set in rapidly and affect the neighbouring healthy fruits within the packaging (Jiang, 2006). Consequently, any fruit with torn stems, fissures, fractures, or insect-inflicted harm should be immediately discarded. Additionally, during the sorting process, any immature fruit or fruit displaying any indications of rot should also be eliminated.(post harvest handling and storage)Once the fruit has been sorted, it is packed into containers for transport and sale. The fruit can also be treated with various post-harvest treatments, such as waxing or the application of fungicides, to improve its quality and extend its shelf life (Holocraft, 1996).Sorting is typically done by hand, with workers selecting the fruit based on the criteria mentioned above. However, there are also automated sorting systems available that use cameras, sensors, and computer algorithms to sort the fruit, improving efficiency and reducing the risk of human error (Post Harvest Management of Fruits, 2018).

2. **Grading:** Litchi are then ranked in order of size, weight, colour, and ripeness. It is graded into several grades to suit various markets. Litchis are divided into two or more grades based on quality in accordance with the established requirements. Grading can refer to either sorting or sizing. In order to differentiate clean products into different grades, make them appealing, and increase their market value, agricultural products are graded (Post Harvest Management of Fruits, 2018). Grading is done using a scale that is mounted to a stand that is on a platform. Fruits of litchi can be sorted/graded based on Size, Weight, Shape, Surface texture, etc.(post harvest handling and storage).

3. **Packaging:** Fruit should be packed as soon as possible after picking because even a little exposure to the sun will cause a significant decline in quality. Litchi is typically packaged in small bamboo baskets or wooden crates for home markets. Litchi leaves or other soft packing materials like paper shavings, wood wool, etc. are used to line them. Fruit must be packaged properly to ensure freshness, quality, and to avoid fruit rot while in transportation for marketing to far-off locations. Fruits should be packed in boxes that are shallow, lightweight, and stiff enough to safeguard the produce. A few ventilation holes and rope handles on either side are required for raising the box. Clusters of fruits and few leaves are present with the fruits (National Horticulture board).

   Most commonly Litchi fruit is often packed into trays, which provide a supportive base for the fruit and protect it from damage. Trays can be made of plastic, paper, or other materials and are usually perforated to allow for air circulation around the fruit. Clamshells are small plastic containers that are designed to hold a single fruit. They are a popular packaging option for litchi, as they provide good protection for the fruit and make it easy to display in retail stores. Litchi fruit can also be packed into bags, which are typically made of permeable material that allows for air circulation around the fruit. Bags can be sealed to create a modified atmosphere around the fruit, helping to extend its shelf life and can also be packed into boxes, which provide good protection for the fruit during transport and storage. Boxes can be made of cardboard or other materials, and are typically used for bulk shipments of litchi. The choice of packaging method will depend on factors such as the size and shape of the fruit, the intended market, and the length of time that the fruit will be in transit. Regardless of the packaging method used, it is important to ensure that the fruit is packed in a manner that minimizes damage and preserves its quality (Post Harvest Management of Fruits, 2018)

4. **Storage:** Proper storage is an important aspect of the post-harvest management of lychee, as it helps to maintain the quality of the fruit and extend its shelf life. Lychee is a perishable fruit and requires proper handling and storage to avoid spoilage and loss. Once litchi fruit is picked, it's not suitable for room temperature storage beyond a short period. To ensure their freshness, they should be stored in a cold environment, which can keep them in good condition for about three to four weeks if there's a delay in marketing. Alternatively, you can place the fruits in ventilated polythene bags and store them at 2°C for up to five weeks without notable quality decline.(Holocraft,1996). A temperature of 7°C is appropriate for brief storage periods of fewer than two weeks. It's crucial to uphold a relative humidity ranging from 90% to 95% during both storage and transportation. The controlled environment storage with oxygen levels between 3-5% and carbon dioxide levels between 3-5% helps reduce skin browning and slows down the deterioration of ascorbic acid, acidity, and soluble solids. However, if oxygen levels fall below 1% or carbon dioxide levels exceed 15%, the fruit may develop off-flavours and a dull, grey appearance in the pulp (National Horticulture board).

   Litchi should be stored at a temperature of between 7-10°C (45-50°F) in a cool, well-ventilated place. Higher temperatures can cause the fruit to deteriorate and spoil more quickly. It should be stored in a place with high humidity to help prevent the fruit from drying out. A relative humidity of between 85-90% is ideal. Proper ventilation is important to maintain the quality of the fruit and prevent spoilage. Litchi should be stored in a place with good air circulation to allow for the exchange of carbon dioxide and

oxygen and handled carefully to minimize damage to the fruit. The fruit should be packed in a manner that minimizes bruising and other types of damage (Jiang, 2006).Proper packaging is important for storing . The fruit should be packed in a manner that protects it from damage, minimizes air exposure, and maintains a high relative humidity. It should be stored for as short a time as possible, as the fruit will deteriorate over time. The fruit should be used or sold within a few days to a week of harvest, if possible. By following these storage guidelines, it is possible to extend the shelf life of the fruit and maintain its quality. Proper storage is important to ensure that the fruit is of the highest quality when it reaches consumers and to avoid spoilage and loss(Post Harvest Management of Fruits, 2018).

VI. RECENT POST-HARVEST MANAGEMENT PRACTICES DONE

In recent years, there have been several advancements in post-harvest management of litchi that aim to improve the storage life, quality, and marketability of the fruit. Here are some of the most recent developments in litchi post-harvest management:

1. **Modified atmosphere packaging (MAP):** MAP is a method that involves controlling the composition of the air surrounding the fruit, which can help to extend the storage life and maintain the quality of the fruit. The most common approach involves using permeable packaging materials, such as perforated plastic film, to regulate the exchange of gases between the fruit and the environment
2. **Controlled atmosphere storage (CAS):** CAS is a method that involves controlling the temperature and humidity of the storage environment to extend the storage life of the fruit. This can be achieved through the use of refrigerated storage rooms or containers that are designed to maintain a specific atmosphere.
3. **Pre-cooling**: Pre-cooling is a method that involves rapidly lowering the temperature of the fruit immediately after harvest. This can help to reduce the respiration rate of the fruit, extending its storage life and maintaining its quality.
4. **Sanitation:** Sanitation is an important aspect of post-harvest management, as it can help to reduce the risk of disease and decay in the fruit. This includes proper washing and cleaning of the fruit, as well as the use of disinfectants and other treatments to kill any pathogens that may be present.
5. **Ethylene removal**: Ethylene is a natural hormone produced by fruits and vegetables that can cause the fruit to ripen and deteriorate rapidly. Ethylene removal is a method that involves using special filters or absorbing materials to remove ethylene from the storage environment, helping to extend the storage life of the fruit (Hodges, 2011).

These are just a few examples of the recent developments in litchi post-harvest management. The use of these techniques is helping to improve the quality and marketability of litchi fruit, and is expected to continue to advance in the future.

VII. TRANSPORT

Transportation is an important aspect of the post-harvest management of lychee, as it helps to ensure that the fruit arrives at its destination in good condition. Proper transportation can help to extend the shelf life of the fruit and maintain its quality. In India, poor transportation conditions are a significant issue with litchi. The primary restrictions, such as

unpaved roads, a lack of refrigeration, and inadequate vehicle suspension, are outside of the growers' control. The situation has improved in practically all litchi-growing states, though, as a result of improvements in transportation infrastructure and road connection. Huge quantities of fruit are now mostly carried by road and occasionally by train from far-off production centres. The collected fruits are packaged and driven by trucks to the local market (Horticulture mission for northeast and Himalayan states).

VIII. MARKETING

Due to their high rate of perish ability, fruits experience greater marketing issues. For horticulture products, NHB (National Horticultural Board) offers a reliable market intelligence service. A few of marketing organisations that work for the good of producers and customers include NDDB and HOPCOM. Lychee is packaged in 10 kg boxes or baskets with a lychee leaf lining for the home market. Lychee is currently delivered in cool-chains and packed in 2-2.5 kg boxes. After being treated with sulphur, the exportable lychee is packaged in boxes weighing 2 to 2.5 kg or 5 to 6 kg(Post Harvest Management of Fruits, 2018).

IX. EXPORT POTENTIAL

1. **Strengths for export:** India is the world's second-largest producer of litchi and has a significant export potential for the fruit. Litchi is grown in several states in India, including Bihar, West Bengal, Uttar Pradesh, and Andhra Pradesh, among others. The export of litchi from India has been growing in recent years, with the country exporting lychee to countries such as the United Arab Emirates, Saudi Arabia, Kuwait, and other countries in the Middle East, as well as to countries in Europe and the Americas(Hodges, 2011). The export is primarily driven by the high demand for the fruit in international markets, particularly during the summer months when it is in season. Although productivity per tree in orchards is poor, it can be raised by using better agricultural techniques. Indian farmers are well familiar with the crop because it has been farmed there since the 18th century. India is recognised as a reliable source of high-quality litchi. In terms of taste and flavour, Shahi and Rose Scented are regarded as two of the best types available. The majority of the country has ideal soil and weather for commercial litchi farming. In contrast to the primary litchi-producing areas like China and Taiwan, India's litchi harvest season commences earlier. India boasts a robust food processing sector, where entrepreneurs are well-versed in the technology, and there is easy access to both equipment and skilled labour (Chandra, 2006).

2. **Weakness in Indian litchi export**: Due to fruit splitting and skin scorching, the Rose Scented variety is extremely perishable. Although there is a lot of germplasm accessible, there hasn't been any meaningful research and development done to enhance varieties and planting materials. Trees with low yields and ineffective productivity are used to make planting material. To replace or modify trees with better planting material, farmers are not willing to compromise yield in the near future. The average size of the seed has become larger over time, which diminishes the amount of pulp and lowers the quality of the fruit(Chandra, 2006).

X. VALUE ADDED PRODUCTS OF LITCHI

Litchi is a highly perishable fruit. In order to keep the fruit available round the year in the market several litchi based products are developed (Reyes,2016) . Farmers are required to sell the gathered litchi as soon as possible to avoid the fruit turning brown and losing its marketability. Additionally, the entire tree is often taken at once and there is no staggered harvesting in the case of litchi. This, coupled with the highly perishable nature of the fruit, results in glut and even distress sale among growers. Throughout addition, litchi is only available within a brief window of time in the summer. The fruit can be transformed into a variety of goods to solve these issues. Several technologies like high-pressure processing (Chaikham et al ., 2017; Hulle et al ., 2017; Kaushik et al ., 2016; Jaya chandran et al ., 2015), pasteurization (Chaikham et al ., 2017) have been adopted to process whole litchi fruit, pulp and juice to enhance the shelf life of litchi based products (Chaikham et al ., 2017; Prakash et al ., 2017). Growers of litchi can easily make a variety of processed litchi products by following basic food safety and processing rules and utilising resources that are readily available locally. Products that have been processed can be kept for a longer time.

1. **Litchi Juice:** Litchi juice is a popular beverage made from the sweet and juicy flesh of the litchi fruit. It is usually consumed fresh or used as an ingredient in various food and beverage products. The juice is known for its sweet and slightly tart flavour and is rich in vitamins and minerals, making it a healthy choice for hydration which can be made by blending fresh litchis and straining out the seeds and skin. It can be consumed as is or mixed with other juices, such as orange or pineapple juice, to create a more complex flavour profile. Some manufacturers also add sugar or sweeteners to the juice to enhance its sweetness. The juice is a popular choice for those who are health-conscious, as it is low in calories and high in vitamins and minerals, including vitamin C, potassium, and magnesium. Itb is also believed to have several health benefits, such as boosting immunity, improving skin health, and reducing inflammation.Overall, litchi juice is a refreshing and healthy beverage that can be enjoyed any time of the day, either on its own or as part of a mixed juice.

Figure 1: Litchi Juice (ICAR-NRCL)

2. **Litchi-Rts:** Litchi RTS (Ready-to-Serve) is a type of litchi-based beverage that is already prepared and can be consumed immediately. It is a convenient and easy-to-drink option for those who want to enjoy the sweet and juicy flavour of litchi without the hassle of preparing the juice themselves. It is typically sold in cans or tetra packs, and can be stored

at room temperature until opened. Once opened, the beverage should be consumed within a few days for optimal freshness and taste.RTS is a popular choice for those who are looking for a healthy and convenient beverage option. It is usually made with 100% pure litchi juice, without any added preservatives, artificial flavours, or sweeteners, Contains litchi pulp (10% v/v), TSS (10ºB), acidity (0.3%), and stabilizer. This makes it a healthier alternative to other sugary drinks, and a great choice for those who are trying to maintain a healthy and balanced diet and can be stored up to 4 months. In addition to its refreshing taste, litchi RTS is also known for its health benefits. Litchi juice is a good source of vitamins, minerals, and antioxidants, and is believed to have a number of health benefits, such as boosting immunity, improving skin health, and reducing inflammation. Overall, litchi RTS is a convenient, healthy, and delicious option for those who want to enjoy the taste and health benefits of litchi anytime, anywhere. (NRCL, 2022)

Figure 2: Litchi RTS (ICAR-NRCL)

3. **Litchi Wine:** Litchi wine is an alcoholic beverage made from fermented litchi juice. It is a type of fruit wine that is known for its sweet and slightly tart flavour, which is similar to that of the litchi fruit itself. The wine is made by first extracting the juice from fresh litchis and then fermenting it with yeast to convert the sugar in the juice into alcohol. The fermented juice is then aged and bottled to produce a finished wine. The alcohol content of litchi wine can range from 8-15% ABV, the wine produced a clean, light amber colour, an attractive aroma of natural litchi fruit and a harmonious wine taste and typically contains 5-6% alcohol (Singh, 012).It is a popular choice for those who are looking for a unique and flavourful drink. It is typically served as an aperitif or as a dessert wine, and can also be used as an ingredient in cocktails and other mixed drinks. In addition to its delicious taste, litchi wine is also believed to have several health benefits, as litchis are a rich source of antioxidants, vitamins, and minerals. Drinking litchi wine in moderation is thought to have benefits for heart health, improve skin health, and boost immunity. However, it is important to note that excessive consumption of any type of alcohol can have negative health effects, so it is important to drink litchi wine in moderation and to always drink responsibly (NRCL, 2022).

Figure 3: Litchi Wine (ICAR-NRCL)

4. **Canned Litchi:** Canned litchis are litchi fruits that have been processed and packaged in cans for preservation and convenience. They are a popular choice for those who want to enjoy the sweet and juicy flavour of litchis without the hassle of having to peel and de-seed fresh litchis. These are typically packed in syrup, which helps to preserve their flavor and texture. Some canned litchis are packed in light syrup, while others are packed in heavy syrup, which has higher sugar content. The syrup also serves to sweeten the litchis, as the canning process can sometimes dull the natural sweetness of the fruit. The canned litchi has a shelf life of around 3 months, after that pink discolouration occurswhich may be due to formation of tin-anthocyanin complex (Singh, 2012). Canned litchis can be enjoyed on their own as a sweet and juicy snack or used as an ingredient in various recipes, such as baked goods, desserts, and sauces. They can also be used to make litchi juice or litchi puree, which can be used as an ingredient in smoothes, ice creams, and sorbets. In addition to their delicious flavour and versatility, canned litchis are also known for their health benefits. Litchis are a good source of vitamins, minerals, and antioxidants, and are believed to have a number of health benefits, such as boosting immunity, improving skin health, and reducing inflammation(NRCL, 2022).

Figure 4: Canned Litchi (ICAR-NRCL)

5. **Litchi Honey:** Honey is a highly well-known foodstuff that is valued for both its nutritional and organoleptic qualities (Islam,2014) .Litchi honey is a type of honey that is made by honeybees that feed on the nectar of litchi flowers. It is a unique and flavourful honey with intense balsamic (licorice and menthol) and woody aroma. It is generally thick, astringent, bitter, slightly acidic and pale yellow in colour (Mahattanatawee,2014).

It is typically used as a sweetener in various food and beverage products, such as teas, baked goods, and desserts. It is also a popular choice for those who are looking for a healthy alternative to processed sugars and artificial sweeteners. Litchi honey is obtained by processing raw honey collected from litchi orchards and contains> 78ºB TSS (NRCL, 2022).In addition to its delicious taste, litchi honey is also believed to have several health benefits. Honey is a natural source of antioxidants, enzymes, and vitamins, and is believed to have a number of health benefits, such as improving digestive health, boosting immunity, and reducing inflammation.

Litchi honey is a specialty honey that is only produced in areas where litchi trees grow, such as Southeast Asia, India, and South Africa. It is important to note that not all honey is the same, and the health benefits and flavour profile of litchi honey can vary depending on the quality of the litchi flowers and the method of production used. Overall, it is a delicious and healthy sweetener that is prized for its unique flavour and health benefits. It is a great choice for those who are looking for a natural alternative to processed sugars and artificial sweeteners (NRCL, 2022).

Figure 5: Litchi Honey (ICAR-NRCL)

6. **Dehydrated Litchi Pulp:** Dehydrated litchi pulp is a form of dried litchi fruit that has had most of its moisture removed. This process concentrates the flavour and nutrients of the fruit into a compact and shelf-stable form that can be easily stored and transported. The pulp can be used in a variety of ways, such as an ingredient in smoothes, baked goods, and energy bars. It can also be reconstituted with water to make litchi juice, puree, or nectar. The reconstituted product can be used in recipes that call for fresh or canned litchis, such as sorbets, ice creams, and sauces and storage life > 1 year under refrigerated conditions. Pulp is a convenient and healthy option for those who want to enjoy the sweet and juicy flavour of litchis without having to deal with the hassle of peeling and de-seeding fresh litchis or worrying about spoilage. It is also a great option for those who are looking for a portable and convenient snack that is high in nutrients and flavour.In addition to its delicious flavour and versatility, dehydrated litchi pulp is also known for its health benefits. Litchis are a rich source of antioxidants, vitamins, and minerals, and are believed to have a number of health benefits, such as boosting immunity, improving skin health, and reducing inflammation (NRCL, 2022).

Figure 6: Dehydrated Litchi Pulp (ICAR-NRCL)

7. **Litchi Nut:** Litchi nuts are the seeds found inside litchi fruits. They are inedible and are typically discarded when the fruit is consumed. However, some people have started to explore the potential health benefits of litchi nuts, as they are believed to contain a number of nutrients and compounds that can have positive effects on health. Nuts are believed to contain high levels of antioxidants, which are compounds that can help protect the body from damage caused by free radicals. They are also a source of essential fatty acids, which are important for heart health, and have been found to have anti-inflammatory and pain-relieving properties. In addition to their health benefits, litchi nuts are also being investigated for their potential use in the production of biofuels and other sustainable energy sources. Litchi nuts contain high levels of oil, which can be processed and used as a source of biofuel. However, it is important to note that more research is needed to fully understand the health benefits and uses of litchi nuts. The seeds are not commonly consumed and are not widely available, so they are not a well-studied food. It is also important to consider the potential side effects of consuming litchi nuts, as they are believed to contain compounds that can be toxic if consumed in large quantities. Litchi nuts are an interesting food with potential health benefits, but more research is needed to fully understand their effects on health and their potential uses(NRCL, 2022).

Figure 7: Litchi Nut (ICAR-NRCL)

XI. FUTURE THRUSTS

After being harvested, litchi fruit quickly degrades due to a variety of factors, including genetics, environmental factors, water loss and desiccation, enzyme activity, fruit senescence, fungus, and heat damage. To preserve the quality and lengthen the shelf life of litchi fruit, packaging technologies including MAP, CAP, and active packaging must be used. For the purpose of measuring produce inside the packaging and its surroundings in real time,

numerous innovative techniques and technologies are now accessible. Technologies and non-destructive methods that enable sensing and communicating quality metrics without opening the package are promising. In order to prevent or limit moisture loss and desiccation, reduce oxidative damage and the activity of oxidative enzymes, and postpone fruit metabolism and senescence, innovative packaging solutions must incorporate a mix of treatments, and control decay pathogens. The marketing condition and market distance should also be taken in to consideration while designing/developing packets(Purbey, 2019).

XII. CONCLUSION

Litchi is very delicate and perishable in nature. It is crucial to harvest at the right stage of development and handles everything carefully. The packaging should have the capability to minimize weight loss, minimize changes in the fruit's physiological and biochemical attributes, shield the product from transportation hazards, and prevent damage from microbes and insects. Exploring other alternatives such as corrugated fibreboard boxes, corrugated polypropylene board boxes, plastic trays, crates, wooden sacks, melded pulp trays, thermoformed plastic trays, stretched film, and shrink wrapping is necessary to align with long-term ecological requirements and achieve cost-efficiency. It is crucial to pre-cool the fruit to remove heat acquired in the field. Post-harvest techniques aimed at reducing browning, preserving the red colour, and extending storage life encompass methods like sulfur treatment, acid dipping, irradiation, and packaging in breathable plastic bags for cold storage (controlled atmosphere - CA). To enhance the post-harvest lifespan of lychees, careful harvesting, pre-cooling, prevention of dehydration, pest control, sulfur treatment, acid dipping, modified atmosphere packaging (MAP), proper transportation, and storage at temperatures between 2-3°C are imperative. Future strategies for handling lychees after harvest will emphasize temperature management and environmentally friendly disease control methods, reducing reliance on chemicals (Purbey, 2019). The future of litchi is promising, as demand for the fruit is expected to continue growing due to its delicious flavor, versatility, and health benefits. With increasing demand for litchi around the world, there is a growing need for increased production and export of the fruit. This will require investment in better production methods and infrastructure, as well as the development of new markets for litchi. Quality control is an important factor in the future of litchi, as it will help to ensure that the fruit is of high quality and safe for consumption. This will require investment in better production and storage methods, as well as improved packaging and transportation.The production of value-added products from litchi, such as juice, wine, honey, and dried fruit, is expected to increase in the future. This will help to increase the value of litchi and create new opportunities for farmers and businesses.

As demand for litchi continues to grow, there will be an increased need for research and development to better understand the fruit's health benefits, production methods, and potential uses. Also sustainability and conservation are important considerations for the future of litchi, as they will help to ensure the long-term viability of the fruit and its production. This will require investment in better production methods, as well as the development of new technologies that can help to conserve resources and reduce waste.The future of litchi is bright, and there is a growing demand for the fruit around the world. With increased production, quality control, value-added products, research and development, and sustainability and conservation, the litchi industry is poised for growth and success in the years to come.

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