POSTHARVEST DISEASES OF FRUITS AND VEGETABLES AND THEIR MANAGEMENT

Abstract

Postharvest diseases pose a significant challenge in the preservation and storage of fruits and vegetables, leading to substantial economic losses and food waste. These diseases are caused by various pathogens such as fungi, bacteria, and viruses, which can thrive in the postharvest environment due to changes in temperature, humidity, and handling practices. This paper reviews the common postharvest diseases affecting fruits and vegetables, discusses their causative agents, and explores management strategies to mitigate their impact. The management approaches encompass cultural, physical, chemical, and biological methods to prevent, control, and reduce postharvest losses. Developing a comprehensive understanding of postharvest diseases and their management is crucial for ensuring food security and enhancing the shelf life of fresh produce.

Keywords: Postharvest diseases, fruits, vegetables, pathogens, management, food security, shelf life.

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I. INTRODUCTION

Diseases that happen after production can cause losses at any point in the process, from harvesting to eating. When figuring out postharvest disease losses, it's important to take into account both the number and quality of fruits that have been lost. This is because some diseases may not make produce unsellable, but they can still lower product value. For example, fruit with blemishes might not be sold as fresh fruit, but it might still be good for making other things, in which case it would sell for less **Beattie, *et al*., (1989).** When figuring out how much money was lost because of postharvest waste, it is also important to think about how much it cost to harvest, package, and ship the food. Aside from the direct cost to the economy, diseased food could be bad for your health. Some types of fungi, like *Penicillium, Alternaria, and Fusarium*, can produce mycotoxins when the right circumstances are met **Pandey *et al*., (2022).** In general, the most likely way for mycotoxins to get into food or animal feed is when sick produce is used to make processed food or animal feed. Most of the time, you wouldn't eat fresh food that was clearly sick **John *et al*., (2019 a) and Maurya *et al*., (2020).** Losses due to postharvest disease are affected by a great number of factors, including:

1. Commodity nature.
2. Cultivar susceptibility to postharvest disease.
3. The postharvest environment (temperature. relative humidity, atmospheresymphony, etc.)
4. Build maturity and ripeness phases
5. Treatments used for disease organize
6. Produce handling methods.
7. Post-harvestsanitation.

We'll talk more about these things later in this chapter.

Fungi and bacteria are the main causes of almost all diseases that affect fruits and vegetables after they have been collected. When root crops and brassicas that were infected with viruses before harvesting, things can occasionally go worse more quickly. However, after-harvest illnesses do not typically have viruses as their primary cause.

After-harvest diseases are frequently categorised based on how they spread. Infections that are referred to as "quiescent" or "latent" occur when the pathogen initially infects the host (often prior to harvest), but ceases acting until the physiological makeup of the host tissues alters in a way that permits the infection to persist. When do dormant bugs start to act up again? Usually, when a fruit ripens and its body goes through big changes, Some postharvest diseases are caused by infections that have been dormant for a long time, like anthracnose, which is caused by *Colletotrichum spp*. in tropical fruits, and grey mould, which is caused by *Botrytis cinerea* in strawberries.

The other big group of diseases that happen after harvest is caused by infections that started before or during harvest. Most of the time, these illnesses happen because of cuts or bites on the skin. Wounds don't have to be big to get infected. In fact, they can often get infected even if they are very small. Blue and green mold, which is caused by *Penicillium spp*., and transit rot, which is caused by *Rhizopus stolonifer*, are two common postharvest diseases that come from wound infections. Bacteria like *Erwinia carotovora*, which causes soft rot, also often get into wounds. Many pathogens, like the banana crown rot fungi, can also get into the plant when the crop is cut off from the plant **Pant *et al*., (2023).**

II. CAUSES OF POSTHARVEST DISEASE

Correctly identifying the pathogen that causes postharvest disease is the most important step in choosing the best way to control the disease. The group Ascomycota and the related Fungi Anamorphici (Fungi imperfecti) are home to many of the fungi that cause diseases after harvest. In postharvest diseases, the anamorph stage of Ascomycota fungi is usually more common than the teleomorph stage. Penicillium, Aspergillus, Geotrichum, Botrytis, Fusarium, Alternaria, Colletotrichum, Dothiorella, Lasiodiplodia, and Phomopsis are all important types of anamorphic postharvest diseases. Some of these fungi also have sexual stages that look like ascomycetes **John *et al*., (2019 b).**

Important postharvest pathogens in the order Oomycota include the genera Phytophthora and Pythium, which cause ailments like brown rot in citrus (*Phytophthora citrophthora* and *P. parasitica*) and cottony leak in cucurbits (*Pythium spp.).* Rhizopus and Mucor are significant subgroups of diseases that infect plants after harvest in the Zygomycota order. A widespread wound infection known as *R. stolonifer* damages a variety of fruits and vegetables. It creates a quick-moving, soft, wet decay. The phylum contains genera. Although fungi like *Sclerotiun rolfsi* and *Rhizoctonia solani*, which have sexual stages that are basidiomycete, can seriously harm crops like tomato and potato after harvest, basidiomycota are not often significant causes of postharvest illnesses.

The host's tissue changes facilitate the spread of an infection. Even though these infections' ailments often manifest in the field, the symptoms frequently worsen after harvest. Different strains of Erwinia, Pseudomonas, Bacillus, Lactobacillus, and Xanthomonas are typically responsible for bacterial soft rots. After they have been harvested, bacterial soft rots are very serious illnesses that affect many vegetables, but they typically have less of an impact on most fruits. This is so because most fruits have low pH levels, which inhibit the growth of the majority of bacterial plant viruses.

III. HOST PHYSIOLOGICAL STATUS

The health of the host tissue has a lot to do with whether or not a disease develops after harvest. It is important to know what happens to a plant's body after it is picked so that the right conditions can be made to prevent diseases from spreading. The physiological processes of growth, development, and aging happen in every plant part. With the exception of seed germination and the sprouting of storage organs, growth and development usually only happen when the organ is connected to the plant. However, senescence will happen whether the organ is attached or not, though at different rates. When a plant's parts, like a fruit, are taken off.

It keeps breathing and sweating, which use up both food and water. In the end, these changes lead to aging. Cool storage is one way to slow down breathing and water loss. So, help to avoid getting old. Different types of goods have very different processes that lead up to aging, which makes it hard to draw general conclusions.

Because of this, the next part will only talk about food. 'Ripeness' and'maturity' are two words that are often used interchangeably when talking about fruit. To put it simply, a person is physiologically mature when their normal growth and development are done. In reality, fruit is considered mature when it has reached a stage where it will ripen to a good quality after being picked and handled afterward. A ripe apple, on the other hand, is one that is ready to eat. The process of ripening is simply a sign that the plant is done growing and starting to age. It can cause a lot of changes in the fruit, like turning starch into sugar and making the pH rise. The fruit gets softer and smells better, the amount of chlorophyll goes down, and the amount of carotenoid colors (yellow and orange) goes up.

The way fruit ripens is often used to divide it into two groups. When a climacteric fruit is getting ready to ripen, its respiration and ethylene output go up a lot. Climacteric fruit can be picked before it is fully ripe, and as long as it is mature enough, it will ripen to a good grade. Fruit that is not climacteric does not show a rapid increase in breathing as it ripens. Fruit that doesn't go through climacteric changes doesn't get better to eat after it's picked, but it may change color or get softer. Because of this, they shouldn't be picked before they are ready to eat.

IV. MODE OF INFECTION

Before, during, or after harvest, fruits and vegetables may become infected by soil-dwelling pathogens. Infections that occur in tropical fruit crops prior to harvest but disappear until sometime during ripening are fairly common. According to Maswada and Abdallah (2013), anthracnose, the most deadly postharvest disease that affects a variety of tropical and subtropical fruits including mango, banana, pawpaw (papaya), and avocado, begins as a dormant infection before harvest.

Anthracnose is also a major disease that affects veggies (like beans) and temperate fruits (like strawberries) after they have been picked. There are many kinds of Colletotrichuum that can cause anthrax. Some species, like *C. musae*, only attack one type of fruit or vegetable. Others, like *C. gloeosporioides*, can attack a wide range of fruits and veggies.

Conidia produce an appressorium and a germ tube when they grow on the surface of the host tissue. Although the fungus has a dormant stage in its life cycle, it is unclear from the results of the several researches whether this stage is the fertilized appressorium or the un-germinated appressorium. It's possible that the fungus behaves differently on various hosts, or that some scientists haven't been successful in identifying appressorial germination because their techniques weren't adequate. *C. gloeosporioides* was inactive in the avocado appressoria that had not yet grown, according to early testing.

Studies done 20 years later, on the other hand, showed that appressoria sprouted to make infection hyphae before quiescence started. In any case, the fungus stops growing soon after the appressorium forms and stays that way until the fruit is ready to eat. During the ripening process, the fungus starts to grow new colonies in the fruit tissue, which causes the usual symptoms of anthracnose to appear.

Colletotrichum infections may be kept in check by natural antifungal chemicals that are found in fruit tissue. Antifungal dienes are found in the peel of young avocado fruit in amounts that stop the avocado anthracnose pathogen, *Colletotrichum gloeosporioides*, from growing. During ripening, the amounts of these dienes drop to levels that are not harmful to fungi. This happens at the same time that anthracnose symptoms appear on fruit. Treatments that increase the production of diene compounds also slow the onset of symptoms, which suggests that these compounds play a role in controlling quiescence.

Grey mold on strawberries, which is caused by *Botrytis cinerea*, is another important disease that can happen after harvest and sometimes comes from infections that were there before harvest but were dormant. When there is moisture, the conidia of *B. cinerea* that are on the top of dead flower parts start to grow. The fungus takes over the dead tissue and stays still at the bottom of the flower's container. Several months later, when the fruit is ready to be picked, the stem end starts to rot, which leads to illnesses. From the end of a fruit's stem, many diseases spread after it has been picked. But the way these diseases spread can be very different from one to the next.

B. cinerea produces sores near the end of the fruit stem as a result of infections in the flowers. Citrus stem end rots are brought on by *Phomopsis citri* and *Lasiodiplodia theobromae*. Diseases that have been dormant in the fruit's stem button are what cause these rots. These infections can begin at any stage of the fruit's development and remain dormant up to the abscission, or the beginning of the button's separation from the fruit. Other stem end rot illnesses, such as banana crown rot, allow the disease to enter the plant during and after harvest through the hole created by the fruit being cut off the plant.

Recent studies have shown that some stem end rot diseases can also be caused by another important way of getting sick. Endophytic infection is important in a number of tropical fruit stem end rot diseases. This is when the fungus colonizes the stem, flowers, and fruit pedicel tissue without causing any symptoms. *Dothiorella domninicana* causes stem end rot in mangoes. This is an example of a disease that happens after the fruit has been picked. In this case, the fungus takes over the pedicel and the end of the stem of an unripe fruit, where it stays dormant until the fruit starts to ripen.

Infections that happen right before harvest cause a lot of diseases that happen after harvest. Such infections might not be obvious at harvest time, but that doesn't mean they aren't still going on. After harvest, symptoms may show up more quickly, especially if the storage conditions are good for bacteria growth. Postharvest ailments brought on by late-season infections include the brown rot of peaches brought on by *Monilinia fructicola*, the grey mould of grapes brought on by *Botrytis cinerea*, the yeasty rot of tomatoes brought on by *Geotrichun candidum*, and the sclerotium rot of various vegetables brought on by *Sclerotium rolfsi*.

Many common postharvest pathogens can't directly get into the skin of the host. So, these pathogens get into the body through cuts or natural holes like stomata and lenticels. Injuries can be very small or very big, and they can happen in many different ways. During gathering and handling, mechanical injuries like cuts, scrapes, pressure damage, and impact damage happen often. Insect damage can happen before harvest but go unnoticed until grading. This makes it easy for many germs to get into the food after harvest. Yeasts usually get into leech fruit through bug bites that are hard to see when the fruit is being picked. Some chemical treatments used after harvesting, like fumigants used to kill insects and disinfectants like chlorine, can also hurt produce if they are not used properly. Physiological damage, like chilling and heat damage, can make produce more likely to get infected by pathogens after gathering.

Tropical fruits, in particular, are very sensitive to low temperatures. Below 13°C, depending on how long they have been stored, many of them show signs of chilling damage. Chilling injury can cause abnormal ripening, discoloration of the peel and meat, water soaking, and pitting. Produce that has been damaged by chilling is much more likely to get sick after it has been picked. For example, pawpaw, apple, and other food crops are more likely to get alternaria rot if they are exposed to too much cold.

High temperatures can also make gathered food more likely to get sick. For example, dipping mangoes in hot water for too long or at too high of a temperature can lead to more stem end rot, which is caused by *Dothiorella spp*. Fruits and veggies lose their natural resistance to disease as they age and get riper. When food has been stored for a long time, weak pathogens that usually need a wound to spread can become a problem. Fruits and veggies that have been stored for a long time are less likely to get sick if they are treated in ways that keep their natural "vitality."

V. TRADITIONAL STRATEGIES FOR POSTHARVEST DISEASE CONTROL AND PREVENTION

1. **Fungicides:** Fungicides are used a lot to keep fruit and veggies from getting sick after harvest. When to use a fungicide and what kind to use depends on the target disease and when the infection happens. Fungicides are often needed to stop postharvest bacteria from infecting crops before they are picked. This could mean using protectant fungicides over and over again during the growing season or using systemic fungicides in the right places. *Colletotrichum gloeosporioides* causes mango anthracnose in Australia. To stop it, trees are sprayed regularly with a protectant fungicide like mancozeb while they are blooming and making fruit. If it rains during lowering, a systemic fungicide is used to kill any infections that have already started and to keep new ones from starting **Masoud *et al*., (2013).**

   Fungicides are often used after the harvest to stop infections that have already started on the surface of the produce or to prevent infections that could happen during storage and handling. For fungicides to work on infections that are dormant in a field but still there when it's time to harvest, they must be able to reach the spot of the infection. Most of the time, systemic fungicides are used for this, but it is not well known how deeply they enter when used in this way.

   Systemic fungicides work better on some tropical fruit crops, like mango, when they are used as warm dips. Fungicides can be used to stop the growth of pathogens when infections happen during and after harvest. How well fungicides do this depends on how bad the illness is when the fungicide is used and how well the fungicide gets into the host tissue. In general, fungicides should be used as soon as possible after harvest to stop germs from getting in through wounds. If the problem is already far along when the postharvest treatment is done, it will be hard to get rid of it. The most common way to stop pathogens from growing in a cut is to keep a certain amount of fungicide at the injury site. This will stop (but not necessarily kill) pathogen growth until the wound has healed. In this way, most of the things that are called "fungicides" and are used after harvest are actually "fungistatic," not "fungicidal."

When pathogens enter host tissue, they cannot be stopped from spreading. Sodium hypochlorite and other disinfectants can be used to eliminate disease propagules on fruit surfaces. Fungicides used after harvest might be applied as fumigants, dips, sprays, treated wraps and box liners, or in waxes and coatings. A lot of dips and sprays are employed. They can be water-based solutions, suspensions, or emulsions, depending on the ingredient. Fungicides like the triazoles (like prochloraz and imazalil) and benzimidazoles (like benomyl and thiabendazole) are frequently applied as dips or sprays.

Fungicides in the benzimidazole group are very good at killing important postharvest pathogens like Penicillium and Colletotrichum. Fumigants, like sulphur dioxide, are sometimes used to get rid of diseases. For example, grey mold (caused by *Botrytis cinerea*) on grapes and different post-harvest diseases on lychees can be stopped with sulphur dioxide. Carbon dioxide, ozone, and ammonia are some other gases that can be used as fumigants.

In some countries, the fungicide biphenyl is used to stop Penicillium from growing on oranges. This is done by putting biphenyl into fruit wraps or box liners. Fungicides are often put on citrus and some other fruits in wax on the line to stop diseases that happen after the harvest. Packing is a way to keep the host resistant to infection by changing the surroundings after harvest.

2. **Maintenance of Host Resistance to Infection through Manipulation of the Postharvest Environment:** Being able to control the environment after harvesting is a great way to prevent senescence. After harvest, temperature may be the single most important thing that affects how diseases grow. Temperature has a direct effect not only on how fast pathogens grow, but also on how fast fruit ripens. Many diseases that happen after harvest are linked to how ripe the fruit is, so treatments that slow ripening also tend to slow disease growth. Fruits and veggies are often stored at low temperatures to delay ripening and the spread of disease, even though the temperatures usually used for storage are not high enough to kill the pathogen. Because of this, produce that has been kept cool and then moved to room temperature to ripen or be sold may quickly get postharvest diseases**Jung *et al*., (2014).**

The temperatures used to store food depend a lot on how sensitive the food is to chilling. For example, many fruits and veggies that grow in temperate climates, like apples, peaches, and broccoli, can be stored at 0°C, but many tropical fruits can't be stored below l0°C without getting sick from the cold. To delay produce going bad, the keeping environment is sometimes changed. Increasing the amount of CO in the storage area and lowering the amount of O can slow down the rate at which fruit breathes. Pathogens can also grow directly because of the storage atmosphere, but the amounts of CO or O needed to do this are often bad for the produce if they are used for long periods. One big exception to this is strawberry, which can store for a long time at the high amounts of CO (20-30%) needed to stop *Botrytis cinerea*, the fungus that causes grey mold, from growing. Short-term exposure to very high amounts of CO has shown some promise for delaying the onset of anthracnose (caused by *Colletotrichum gloeosporioides*) symptoms in avocado, but these treatments are not yet available for sale. Postharvest diseases can be caused by a lot of different things, but one of the most important ones is the relative humidity of the holding area. Produce often doesn't lose as much water when the humidity is high.

This, though, can make diseases spread, especially if free water builds up in storage bins. Most of the time, the humidity level chosen to store food is a "trade-off" between reducing water loss and preventing disease.

VI. CLEANING PRACTICES

It is important to keep up cleaning at all stages of production and postharvest handling to reduce the number of places where diseases can start. To lower inoculums most effectively, you need to know a lot about how the pathogen lives. Sources of inoculums for diseases that happen after harvest depend a lot on the culprit and when it happens. When diseases that happen after harvest are caused by infections that happened before harvest, methods that make the crop environment less friendly to pathogens will help reduce the number of infections that happen during the growing season. For example, in tree crops, pruning and skirting can make the tree top more airy, making it less likely that fungi and bacteria will grow their **Champ *et al*., (1984).**

One important way to keep inoculums from building up is to get rid of dead twigs and leaves that are stuck in the tree canopy. In many diseases, overhead irrigation can make it easier for pathogens to spread and for people to get sick. In these cases, trickle or micro-sprinkler watering systems may be better.

Since many pathogens come from the soil, it is best to keep leaves and fruit from coming into touch with it as much as possible. Infections that happen after harvest often start in the packing shed or storage area where the crops were kept.

1. Water that is used to wash or cool food can become contaminated with disease propagules if it is not changed often and doesn't contain a disinfectant like chlorine. In some cases, the temperature of the water can also be a big part of how inoculums are moved. For instance, tomatoes picked in hot weather may be hotter than the water used to wash them. In this case, the fruit tissue can absorb inoculums from the washing water, which can make diseases like bacterial soft rot worse.
2. Reject produce that hasn't been thrown away from the packing shed or storage area is a great place for postharvest pathogens to grow.
3. Packing and grading equipment, especially brushes and rollers, that isn't cleaned and sanitized regularly, can also be a major source of pathogen propagules.
4. This is especially true if the same containers are used to store and transport fruit more than once without being cleaned properly.

VII. PRE-HARVEST FACTORS

Postharvest disease can be caused by a wide range of things that happened before the harvest. The weather (rain, temperature, etc.) is one of these. production location, choice of cultivar, cultural techniques (pesticide use, fertilization, watering, planting density, pruning, mulching, fruit bagging, etc.), and planting material. These things may have a direct effect on the spread of disease by lowering the number of inoculum sources or making infection less likely. Or, they may change the way the produce works in a way that makes it more likely to get sick after it has been picked. For example, putting certain nutrients on fruit skin makes it "stronger," so it is less likely to get hurt during picking and less likely for pathogens to get in through wounds **Fallik *et al*., (2000; Frances *et al*., 2006).**

Injury prevention is important because many postharvest pathogens get in through wounds or affect tissues that have been damaged physiologically. This means that injury prevention is important at all stages of production, harvest, and postharvest handling **Fortunati *et al*., (2017).** Mechanical injuries include cuts, bruises, and abrasions. Chemical injuries include burns. Insect, bird, and rodent harm are examples of biological injuries. By being cautious when picking and handling food, properly packing it, managing insect pests in the field, maintaining the proper temperature, and using the proper postharvest treatments, injuries can be reduced to a minimum. By altering the postharvest environment (such as the temperature and humidity) or by applying specific chemical treatments, the healing process can occasionally be sped up when there are wounds. It has been demonstrated that a wound's ability to heal is correlated with a person's resistance to particular postharvest illnesses, such as the bacterial soft rot of potatoes brought on by *Erwinia spp.*

VIII. HEAT TREATMENTS

Some diseases that happen after harvest can be stopped by using heat treatments. Heat works by either killing the bacteria (and/or its offspring) or slowing its growth after treatment. But the physical ways in which goods can handle heat processes vary a lot. For example, most fruits that grow in temperate zones are very sensitive to damage from heat. Especially at the temperatures that are needed to stop diseases. Hot air or hot water can be used to heat up things that can handle it. Hot water is a better way to spread heat than hot air, but it is also more likely to hurt the thing being heated. Fungicides and hot water are often used together to prevent diseases in mango, pawpaw, and rock melon after they have been picked. Treatments with hot air, which are often used to get rid of fruitflies in different harvested goods, can also help control some postharvest diseases.

IX. IONIZING RADIATION

Another physical remedy that can be applied after harvest to reduce disease in specific crops is ionising radiation. Goods must be able to withstand the ionising radiation dosages required to prevent disease, much like with heat. Some products are surprisingly simple to use. Strawberries, for instance, can withstand the radiation dosages required to eradicate the grey mold-causing fungus *Botrytis cinerea*. In other goods, however, ionizing radiation at doses that kill the target bacteria can cause abnormal ripening, softening of the tissue, and off-flavors. Food irradiation isn't widely accepted by consumers, and the cost of treatment is high, which makes it hard to use this technology on a large scale right now.

X. EMERGING TECHNOLOGIES FOR POSTHARVEST DISEASE CONTROL

Pesticide residues in food are becoming a bigger worry for consumers, so people are looking for ways to stop diseases without using chemicals. Fungicides that are used after harvest are especially dangerous because they are used close to the time when the food will be eaten. Several new ways to stop diseases after harvest are being looked into right now, including biological control. Natural fungicides and natural tolerance in the host.

XI. BIOLOGICAL CONTROL

In recent years, there has been a lot of interest in using germs that fight each other to stop diseases that happen after harvest. Such organisms can be found in fermented foods and on the surfaces of leaves, fruits, and veggies, among other places. Once bacteria, yeasts, or filamentous fungus are found, they can be tested in different ways to see if they can stop certain pathogens from spreading. Most of the time, the pathogen is stopped better when the antagonist is used before the illness starts. Because of this, it is often harder to get rid of dormant field infections (like *Colletotrichum spp*.) by applying inhibitors after harvest than it is to get rid of infections that happen after harvest (like *Penicillium spp*.) **Kolaei *et al*., (2013).**

Unless an antagonist has an eradicant effect or has some kind of effect on how the host's defenses work, field uses are often needed to get rid of infections that have stopped spreading. *Bacillus subtilis* and *B. licheniformis* are used in the field and after the harvest to stop anthracnose (caused by *Colletotrichum gloeosporioides*) and stem end rot (caused by *Dothiorella spp*. and other fungi) in avocados in South Africa. Some of the ways that pathogens and antagonists work together are site exclusion, competition for nutrients and room, and making antibiotics.

In Australia, however, only field uses of a strain of *Bacillus spp*. that does not make antibiotics have shown promise in stopping anthracnose in avocados. Biological control of wound pathogens in different fruits and vegetables has been written about in a number of studies. For an enemy to work against wound pathogens, it must be able to colonize wound sites so well that the pathogen can't live there. Postharvest pathogens can be stopped by yeasts like *Pichiaguilli ermondit*, *Cryptococcus laurentii*, and *Carndida spp.,* which compete with the pathogens at wound sites **Geng, *et al*., (2011).** Even though biological control of postharvest diseases has the potential to work, success in the future depends on being able to get the same results in the field and after harvest. The effectiveness of biological control agents against postharvest diseases will need to be improved, and the science behind them will need to be made available to the public. In a perfect world, an antagonist would be effective against many different viruses on many different fruits and vegetables. Additionally, it may be produced on inexpensive growing media and would be unique. These inhibitory formulations ought to be inexpensive to produce and have a long shelf life.

Most bad guys don't meet all of these requirements. Many of them work against germs in very specific ways, which may not be very appealing to potential investors. Built-in and triggered host defense.

XII. CONSTITUTIVE AND INDUCED HOST RESISTANCE

Plants have different molecular and structural defenses that keep them from getting sick. Some of these defenses are already in place before the pathogen arrives (this is called "constitutional resistance"), while others are only turned on when the pathogen is present (this is called "induced resistance"). We don't know a lot about how harvested plants react to host defences compared to plants that are still living, although there is considerable research in this area. For instance, in avocado, researchers in Israel and Sri Lanka are examining the molecular mechanisms that aid the host in combating anthracnose. Kuc, J. (1982). In ripe fruit, amounts of preformed antifungal diene chemicals that are fungitoxic in unripe fruit are less lethal. Once the fruit begins to ripen, this enables the pathogen to flourish.Different treatments, such as challenge inoculation with either pathogenic or non-pathogenic strains of Colletotrichum, or treatment with certain antioxidants or high concentrations of CO, can increase levels of the diene chemicals. Phytoalexins, in contrast to pre-existing antimicrobial compounds, are only produced in response to pathogen invasion, albeit they can occasionally be produced through certain chemical and physical processes. For example, it is known that non-ionizing ultraviolet-C light makes plants make phytoalexins. When carrot slices are exposed to UV light, they make 6-methoxymellen, which stops *Botrytis cinerea* and *Sclerotinia sclerotiorum* from growing. Citrus has also been said to be affected. Chitosan, which is a natural substance found in the cell walls of many fungi, is also being looked into as a way to make the host's defenses work **Falguera *et al*., (2011).**

Chitosan can speed up many things, like the production of chitinase. Phytoalexins build up and lignifications get worse. Other chemicals (like salicylic acid, methyl jasmonate, and phosphonates) and treatments (like heat) can also trigger host defenses in collected goods. Natural fungicides: Many of the chemicals that microorganisms and plants make on their own can kill mushrooms. Chitosan, for example, not only makes the host's defenses work better, but it also kills mushrooms and other pathogens that grow after harvest **Fabricio *et al*., (2010).** Antibiotics made by different species of Trichoderma are very effective against important plant pathogens like *Botrytis cinerea, Sclerotinia sclerotiorum, Corticium rolfsi*, and others **Fatemi and Borji (2011).**

XIII. NATURAL FUNGICIDES

There are a lot of other natural chemicals that have been found to kill fungi and have been isolated. From a consumer's point of view, these compounds may be better than synthetic chemicals, but their possible toxicity to humans needs to be tested before they can be used in products. On the bright side, the fact that many of these chemicals are very specific also means that they break down quickly in nature.

XIV. CONCLUSIONS

Fruits and veggies can carry a wide range of dangerous bacteria and fungi. Some of these affect crops before they are picked, but the disease doesn't show up until after harvest, when conditions are better for it to do so. Other pathogens can get into food before, during, or after harvesting by getting into skin wounds. When making plans for controlling diseases after harvest, it is important to take a step back and look at the whole production and postharvest handling systems. Even if an illness happens after harvest, many things that happened before harvest have a direct or indirect effect on it.

Fungicides have traditionally been the most important way to stop diseases after harvest. But the move toward using less chemicals in gardening is forcing people to come up with new plans. This is a fun problem for the 21st century to solve. Cause postharvest disease inAustralian United Fresh Fruit and Vegetable Association Ltd. (1989). Fresh producemanual: handling and storage practices for fresh produce. Australian United FreshFruit and Vegetable Association Ltd, Footscray, Victoria.

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