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Post-Harvest Treatment

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Abstract—*The proper management of agricultural products is necessary during post-harvest period because once harvested these agriculture products are subjected to active process of degradation. According to the FAO, food production to feed world population which will reach 9 billion by 2050,70%of increase in food production is necessary. In addition to getting good yield it is necessary to maintain the produce in good condition till it reaches the consumers. More over there is decrease in land of cultivation this leads to decrease in food so we have to protect even the less quantity of foods so that we can resolve these problems to some extent because it is comparatively easier to reduce losses than increasing yield. Mostly fruits and vegetables are highly perishable. According to central institute of post-harvest engineering and technology, Ludhiana, Punjab, about 16% fruits and vegetables were lost due to post-harvest loss during 2012- 2014 which is equal to Rs.40,811 and according to ministry of food processing industries,2016, harvest and post-harvest loss is Rs.92,651 in India's major agriculture produce. So proper post-harvest treatments are necessary to reduce food insecurity and also to develop economically.*

Keywords*: - post harvest treatment, post-harvest loss in agriculture produce, new advances, food insecurity.*

1. INTRODUCTION

Main problem the world is facing these days is the supply of food to the increasing population means the food insecurity and the whole world is concentrating on how to increase the yield and productivity. This review article concentrates on other side of the solution i.e., protecting the harvested produce we got by minimising the post-harvest losses.According to the FAO, food production to feed world population which will reach 9.1 billion by 2050,70%of increase in food production is necessary andAccording to central institute of post-harvest engineering and technology, Ludhiana, Punjab, about 16% fruits and vegetables were lost due to post-harvest loss during 2012- 2014 which is equal to Rs.40,811 and according to ministry of food processing industries,2016, harvest and post-harvest loss is Rs.92,651 in India's major agriculture produce.so by following good post-harvest management practices we can reduce these huge losses and increase the supply of food to meet the global demands. There are various treatments that can be that can be followed from the day of harvest till it reaches the final consumer. This review lights on the various methods of post-harvest treatments as a brief and new advance made in this.

2. HARVESTING

The process of removal of economic parts after attaining a maturity is called harvesting. Maturity indices indicate the time of harvest and these vary among different crops (or plants).

Table 1. Maturity indices

Index	Examples
Elapsed days from full boom to harvest	Apples, pears
Mean heat units during development	Peas, apples, sweet corn
development of abscission layer	Some melons, apples
Surface morphology and structure	Cuticle formation of grapes, tomatoes Netting of some melons Gloss of some fruits (development of wax)
Size	All fruits and many vegetables
Specific gravity	Cherries, watermelons, potatoes
Shape	Angularity of banana fingers Full cheeks of mangos Compactness of broccoli and cauliflower
Solidity	Lettuce, cabbage, brussels sprouts
Textural properties	
Firmness	Apples, pears, stone fruits
Tenderness	Peas
Colour, external	All fruits and most vegetables
Internal colour and structure	Formation of jelly-like material in tomato fruits Flesh colour of some fruits
Compositional factors	
Starch contents	Apples, pears
Sugar content	Apples, pears, stone fruits, grapes
Acid content, sugar/acid ratio	Pomegranates, citrus, papaya, melons,kiwi fruit
Juice content	Citrus fruits
Oil content	Avocados
Astringency (tannin content)	Persimmons, dates
Internal ethylene concentration	Apples, pears

Source: -Kader, A.A. 1983. Postharvest quality maintenance of fruits and vegetables in developing countries [1].

3. HEAT TREATMENT

Heat treatment includes, hot water rinsing and brushing, hot water dip (HWD), vapor heat, hot dry air and curing[5]. During heat treatment membrane undergoes some changes and a calcium channel is activated and calcium influx in turn activates signal transduction. This signal transduction is also activated by alterations in protein stability, accumulation of ROS and various changes that can be seen in **Figure 1**. which shows the schematic model of temperature sensing in plants and ultimately this transduction leads to temperature tolerance[7].According to thereis increase in firmness of citrus and musk melon fruits due to increase in lignin content by heat treatment. By dipping grape fruit in hot water for 2 min at 50◦C, blue mould (causal organism: - *Penicillium sp*.) can be treated [8]. By using biocontrol agents like antagonistic yeasts heat treatments can be followed along with some eco-friendly treatments [9]see **Figure 2.**

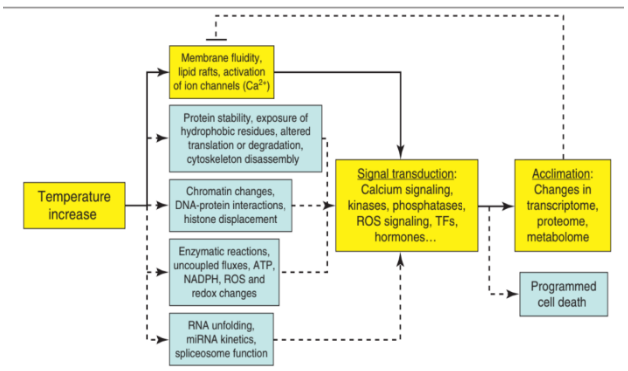

Figure 1.Schematic model of temperature sensing inplants

Source: -Mittler et al.,8 2012. Fundamental aspects of post-harvest heat treatments[6].

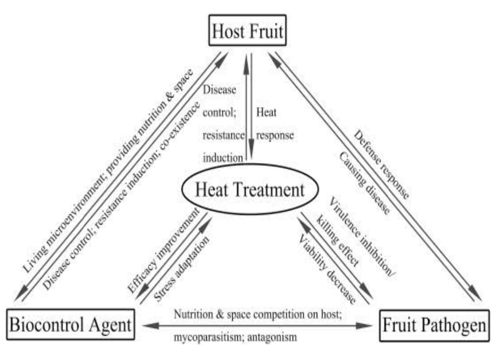

Figure 2. Heat treatment along with bio control agents.

source: - Yuan Sui et al., 2016. Recent advances and current status of the use of heat treatments in postharvest disease management systems: Is it time to turn up the heat? [9].

To control post-harvest decay citrus can be treated with sodium carbonate, *Bacillus amyloliqeifaciens*HF-01 and hot water [10]. Heat treatment can also be used as an alternate to chemical treatments mostly in case of organic crops. Using UV-C light we can reduce postharvest diseases and with increasing fruit ripeness these resistance effects declines [11]there is accumulation of chitinase, b-1,3-glucanase, and phenylalanine ammonia lyase (PAL) due to induction of UV-C light [12].

4. COLD STORAGE

Cold storage is mainly used for maintaining good quality of commodities. When compared to fruits kept in low moisture environment, fruits in cold storage have more resistance to pathogen attack.[13]. Chilling injury can be reduced and tolerance to chilling can be increased in tomato by application of salicylic acid which causes increase in proline content which helps in chilling acclimatization anddecrease PLD and LOX activity and MDA content which leads to enhancement of membrane integrity[14].

5. EDIBLE COATINGS

edible coatings are also used as physical treatments which are thin layers of external coatings on fresh fruits[15].**Table 2** constitutes some of the edible coatings with respective purpose.

Table 2: Edible coatings with respective purpose

coating material	purpose of coating
guar gum; pea/potato starch ± potassium sorbate	antimicrobial
candelilla wax-based	antimicrobial; antioxidant; quality
soya bean gum; jojoba wax; glycerol and arabic gum	overall quality
Shellac ± Aloe vera gel	keeping quality
soy protein; carboxymethyl cellulose	antioxidant; H_2O barrier
chitosan; zein	antioxidant; H_2O barrier
beeswax; coconut and sunflower oil	antimicrobial; antioxidant; quality
pectin base; alginate; carboxymethyl cellulose	antioxidant; H_2O barrier
chitosan; methyl cellulose	antimicrobial; antioxidant; $O_2/CO_2/H_2O$ barrier
soy protein; carboxymethyl cellulose	antioxidant; H_2O barrier
pectin base	overall quality
Aloe vera gel	overall quality
agar; chitosan; acetic acid (combined)	antimicrobial; O_2/CO_2 barrier
whey protein; rice bran oil	H_2O barrier; overall quality
chitosan	overall quality
sucrose-polyester based	H_2O barrier; antioxidant activity
alginate and gellan based	$O_2/CO_2/H_2O$ barrier

Source: - Postharvest treatments of fresh produce P. V. Mahajan et al.,2014. [3]

6. CURING

Curing is done in some root crops like potatoes before storing them where they are placed at 90–95% relative humidity (RH) and 15–20 °C for at least 5days [16].By Curing the damaged areas of tuber are strengthened by development and suberization of new epidermal tissue and it helps reducing water loss and it is a nonchemical which is used widely for reducing decay rot, (FAO, 1989).**Table 3** shows curing treatments of some of the root crops.

7. IRRADIATION

Use of gamma rays, X-rays etc., on foods is called food irradiation. Cobalt 60 or Caesium 137 emits gamma rays. The sources of irradiation used on food are managed by Food and Drug Administration (FDA).kilograys (kGy) is the unit of measurement of irradiation. 1 kGy = 100 kilorad. Use of irradiation enhances the quality of food by Control of sprouting and germination, Delaying ripening and aging of fruits. Shelf life extension of perishable foods, and vegetables and Destruction of parasites. according to value of kGy Used irradiation is of three types [17]

Table 3: Curing treatments of some of the root crops.

crops	Temperature (°C)	RH	Duration (Days)
Cassava root	30-40	90-95	2-5
Onion and garlic bulbs	30-45	60-75	1-4
Potato tubers	15-20	85-90	5-10

1) Low doses of irradiation (Radurization) -less than 1 kGy

2) Medium doses (Radicidation) - from 1–10 kGy

3) high doses (Radappertization)-more than 10 kGy

Low doses are mostly preferred as do not cause severe irreparable damage to produce.

Some of irradiation treatments are shown in **Table 4**along with crops on which it is used.

Table 4: Irradiation Treatments

produce	Purposes	Dosage (kGy)
Bulbs, roots and tubers	To inhibit sprouting during storage	0.05-0.15
Mushrooms and asparagus	Delayed growth	0.05-0.15
Banana, mango, papaya	Delayed ripening	0.25-0.50
vegetables	Delayed post-harvest diseases developed by plant pathogens	>1.75

Source: - AdekaluAbidemi Olabisi et al., 2017 food quality and safety in post-harvest research.[18]

8. MINERALS IN POST-HARVEST TREATMENT

Minerals like calcium are also used in post-harvest treatments to increase shelf life and quality. For post-harvest treatment calcium can be applied by dipping-washing method and by impregnation and by using these types of minerals we can also increase the nutritive quality of produce[19].

9. CHEMICAL AND GASEOUS TREATMENTS

Chlorine dioxide treatment is used to remove pesticide residues on fresh lettuce [20].Nitric Oxide gas can be released from compounds such as S-nitroso thiols, sodium nitroprusside, diazeniumdiolates. NO can be applied as fumigant or dip treatment to reduce ethylene production by binding of NO with 1-aminocyclopropane-1-carboxylic acid (ACC) that forms a stable ternary complex[21].Nitric oxide can be applied exogenously to increase postharvest storage life [22].By inhibiting the ethylene production, we can extend shelf life as ethylene is responsible for ripening for this purpose chemical agents like 1-methylcyclopropene can be used but still research is going on ice lettuce [23].Ozone gas is also used in post-harvest treatment. And the process is called ozonisation. When pineapples and bananas are exposed to ozone for around 20 min. there is an increase in flavonoids and phenolic acids [24]. As ozone decomposes to oxygen it does not leave any residues on treated produce and it also helps in removal other harmful residues like pesticides[25].

10. FUTURE SCOPE AND CONCLUSION

One of the recent developing techniques is Plasma treatment. Plasma treatment at 20 W for 1 min successfully inactivated E. coli by 4 log-cycles on corn salad leaves[26]. Polyamines are known to act as anti senescence agent by reducing respiration rate, inhibiting ACC synthesis which is necessary for ethylene production and increasing firmness of fruit by reducing softening mechanism of fruit[27] [28][29].Whatever may be method of treatment used our main motto is to reduce post-harvest losses besides protecting the quality of produce. Research is going on in many areas for improving or developing the post-harvest treatment techniques.

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