Grapes Storage

Pre and Post-Harvest Storage

STOREX
CONTROLLED ATMOSPHERE

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References:

- Case study from University of Applied Sciences-Van Hall Larestein (part of Wageningen UR).
- Journal of the National Foundation of Sri Lanka.
- A.K. Thompson,Fruit and Vegetables-Harvesting,Handling and Storage.

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1. Grapes History and Description

1.1.History

A grape is a fruit, botanically a berry, of the deciduous woody vines of the flowering plant genus Vitis vinifera. Grapes can be eaten fresh as table grapes, used for making wine, jam, grape juice, jelly, grape seed extract, vinegar, and grape seed oil, or drie as raisins, currants and sultanas.

1.2.1.1.Description

Description. Grapes are a **type of fruit** that grow in clusters of 15 to 300, and can be crimson, black, dark blue, yellow, green, orange, and pink. "White" grapes are actually green in color, and are evolutionarily derived from the purple grape. ... Grapes are typically an ellipsoid shape resembling a prolate spheroid.

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1.3. Value Chain

1.4.Quality Attributes

Quality of grapes but also other fresh produce is defined as the degree of superiority and is an integrated of different attributes, properties or characteristics that add value to each product in terms of its use. The importance of factors of quality relies upon the type of the

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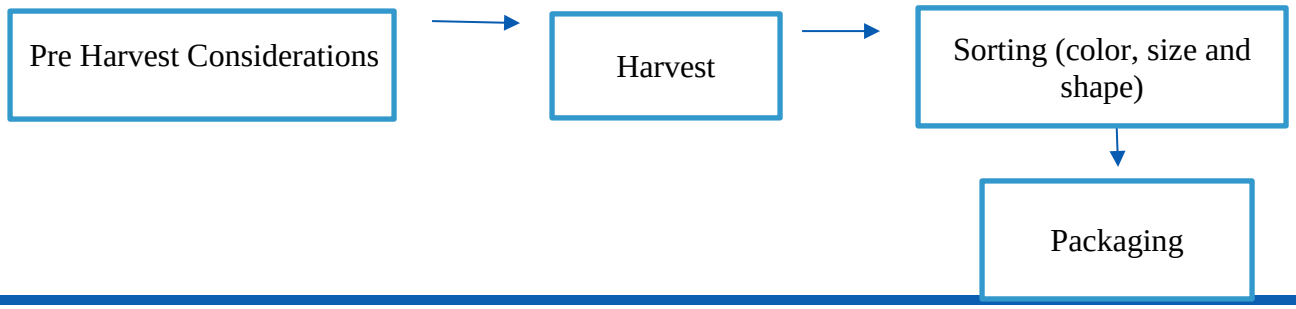
product and how it is consumed and differentiates among producers, handlers, and consumers. Producers consider quality as high return and good appearance of the commodity, simple to harvest, and its withstanding long-distance distribution to reach markets.

1.5. Pre Harvest consideration

Pre-harvesting is much more important than handling in later stages in the process. Hence, it is necessary to control diseases such as Botrytis and powdery mildew, which are the biggest threat to the quality of table grape production in the area. Preventing grapes from physical damages like bird and insect damage are very critical to the quality as well.

2. Harvest and Packing

Harvesting should be done carefully without any mechanical damage and product loss, as quickly as possible with minimizing the cost. The common method of harvesting tabel grapes is hand-harvesting. It has many advantages like avoiding mechanical damages by careful handling during harvest, best selection of fruit clusters in the vineyard in regards to the maturity and appearance, and minimizing capital investment. The optimum time for harvesting is when the fruits obtain the acceptable level of consumers' preference, mostly determined by focusing on level of sugar and acidity. Measurement of sugar 8 level in grapes is done by total soluble solid concentration using a refractometer and sodium hydroxide is used to measure the acidity.



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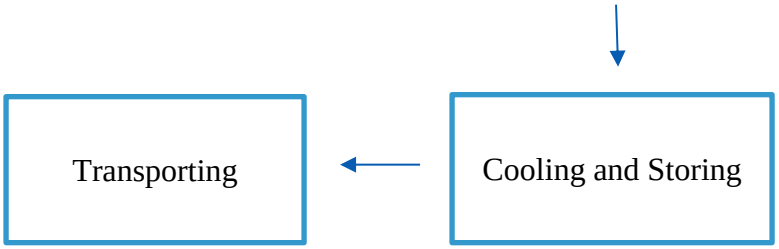

Harvesting and packing table grapes during the hot hours of the day when the temperature goes beyond 30 ^{0}C is not suitable, In these situation only harvesting in the early morning is advised by holding harvested grapes in a pre cooler or cool room to reduce the field heat. There is a negative impact of high temperature on the quality of table grapes after harvesting like shattering of berries, stem browning and splitting of berries.

2.1. Harvest time

The harvest season typically falls between **August & October in the Northern Hemisphere** and **February & April in the Southern Hemisphere.** With various climate conditions, grape varieties, and wine styles the harvesting of grapes could happen in every month of the calendar year somewhere in the world. Harvesting period for grapes, generally starts **30-70 days after fruit set**, by the time berries change color from green to yellow (for white varieties), or red-purple (for red varieties). During this stage, we normally have an increase in sugars and a decrease in acids inside the fruits.

2.2. Harvesting Tools

Grapes are harvested with simple harvesting (cutters, local baskets, wheeler and hand for trimming) materials and remaining four percent is using both simple and standard (Cutting shears, Plastic lugs or baskets, clipping scissors) harvesting materials. A mechanical grape harvester is also used with the benefit of relatively low cost.

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Grapes are harvested early in the morning by the grape growers (family members, hired labors), and then brought to a collection point in the vineyard, which most of the time is a tent under a tree for sorting and packing or under shades of vine tree. Grapes are then trimmed, sorted and packaged.

2.3. Post-Harvest

Maturity Indices:

Harvest date is determined by Soluble Solids Concentration (SSC) of 14 to 17.5% depending on cultivar and production area. In some situations, the SSC/titratable acidity (TA) ratio of 20 or higher is used to determine maturity for early ripening varieties of early production areas. For red and black colored varieties, there is also a minimum color requirement.

Optimum Temperature:

Grapes can be stored at -1.0 to 0° C. The highest freezing point for berries is -2.1° C, but freezing point varies depending on SSC.

Optimum Relative Humidity:

90-95% RH and an air velocity of approximately 6-10 meter per minute (MPM) is suggested during storage. Rates of Respiration (of grape clusters, i.e. berries + stems) At a temperature of 0° C (32° F) the respiration rate (mL CO2/ kg-1/ hr) is about 1-2-at 5° C (41° F) the respiration rate is 3-4, at 10 ° C it is 5-8 and at 20° C (68° F) it is about 12-15. Stem respiration rate is approximately 15 times higher than berry respiration. To calculate heat production, multiply ml CO2 kg-1 hr-1 by 440 to get BTU ton-1 day-1 or by 122 to get kcal metric-1 ton day-1. So the CO2 production is direct related with the heat production

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3. Storage

3.1. Cooling and quality during storage

Cooling is one of the critical phases of post-harvest handling of grapes; therefore, it is necessary to eradicate the field heat from the grape fruits after harvest. This helps to reduce the rate of fruit respiration and minimize water loss from the fruit. Temperature is one of the other factors that influence the quality of grapes. Harvested grapes will become worse when the temperature increase, for example the effect of 32°C in one hour is more than the effect of 4°C in one day and 0°C in one week. Therefore, the amount of time between harvesting grape fruits and cooling is important for the end quality of table grapes.

3.2. Water Loss

Water loss is one of the main changes that occur during storage. The effects of this water loss can be visible like browning of stem. When the loss of water reaches 3-5% fruit berries lose turgidity and firmness. Normally 0°C with relative humidity of 95% can be an ideal temperature for grapes. Regular air circulation is necessary in the cold store to minimize the water loss of the stems. Building a cold storage with high standards needs high investment which is the main purpose of cold storage is to reduce and keep the temperature low with high (95%) relative humidity.

3.3. Temperature

One of the main environmental factors that influence the quality of harvested fruits is temperature, for instance if the temperature increases 10°C over the optimum rate,

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there will be an increase of three fold on deterioration of quality. Quality deterioration of fruits like losing water, appearance, textural quality and nutritional quality is as a result of placing fruits to undesirable temperature.

3.4. SO_2 Treatment to Grapes

Harvested grapes are fumigated with Sulfur Dioxide. There is a fumigation method called the Total Utilization System that results in no excess Sulfur Dioxide fumigant at the end of the fumigation process, thereby reducing air pollution and residues on the grapes.

- To control gray mold rot (*Botrytis cinerea*) – This is one of the main postharvest issues that grapes encounter since the *Botrytis cinerea* pathogen that causes the disease can grow at low storage temperatures, which is how the grapes are stored in order to prolong their shelf-life. The disease originally starts in the field and continues during the postharvest life.
- To reduce the darkening of the rachis – As the grapes continue respiring postharvest, their rachis darken. (The rachis is what holds all of the grapes together in the cluster.) It is a minute detail that us grape lovers do not pay attention to when slurping up grapes, but it is important from a marketing perspective.

Most commonly in addition to the fumigation method, is the use of Sulfur Dioxide generating pads with a box plastic liner that are placed inside the grape boxes during transport. Under proper temperature conditions, these pads slowly release Sulfur Dioxide throughout transport, and absorb moisture generated by the grapes.

4. Controlled Atmosphere (CA)

4.1. Technology of the controlled atmosphere of the grapes

The storage of grapes in low Oxygen and high Carbon Atmospheres is extending rapidly. Losses can be reduced by twice or three times and storage can be extended by 1.5-2 months, and even more while still maintaining the high quality of grapes. It is recommended to pick grapes at the physiological ripening stage, to reduce the delay between picking and storage and provide an optimum gas composition with suitable temperature and humidity.

The variety of fruit and the stages of ripeness largely determine the conditions of the controlled atmosphere. However, the conditions of the controlled atmosphere may

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be general. The conditions of the controlled atmosphere(CA) reduce the loss of The lowest possible oxygen level is 2%. The primary role is played by the increase of carbon dioxide as it inhibits Botrytis. The variety and the stage of maturity determine the limits for the tolerance of carbon dioxide.
In the following table are presented indicatively the suggested CA conditions.

Varieties	Storage duration
Thompson Seedless (Sultanina)	2-3 months
Flame Seedless	2 months
Red Globe	1 month
Muscat	2 months
Emperior	3-5 months
Malaga	2-3 months

4.2. Control and storage of the CA

After the application and installation of the CA conditions the storage protocol implements a number of controls as defined, with predefined frequencies.

- **Control of the temperature with a product sensor in a cold room and in covers.**
- **Control of the CA conditions that is measured in the covers by the system and compare these with the set values. Controle each week the CO_2 and O_2 condition with in the cover and CA room with a handheld meter.**
- **Control of the system alarm.**

The quality of the product is being checked by the covers during the storage period. In order to acquire a rapid synopsis of the quality is indicated a control of the locations in covers that are going to be used for short-term storage and in products from other sources or with different ripeness. It is also possible to control the quality of all the batches on a monthly basis by loading one Pallet with all the sources. This prevents from having other Units to be opened.

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After taking the product out of the cover ,in order to achieve additional quality control, let of a batch for 5 days in a room with 18°C and then control the quality once again.

After a Unit is opened and depending on the duration of the allocation channel, the grapes are becoming once more sensitive to the mold and deteriorate their quality, the SO_2 pad treatment is applied for a slow release of SO_2 in the packaging.
It is recommended to keep the temperature of the product after the CA storage as close as possible to the -1°C – 0.5°C.

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