Post Harvest of Herbs

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In recent years, much development has taken place in methods for handling produce after harvest, which generally bring about a reduction in use and increase of oversight of pesticides. The old approach, where most effort was invested in growing the produce instead of styling, preserving, and packaging it, has largely made way for the new approach. Regulations and protocols have been instituted over the years for agricultural food production. Many regulations are in place for agricultural manufacturing processes which are required by consumers and leading franchises worldwide, including: ISO 9001, MPS, HACCP, QS, F2F, BRC, Nature's Choice, and others. Many regulations appear more than once in the various protocols. After the Food Safety Law was passed in England in 1990 and the demand for quality produce in Europe grew, the EU instituted a uniform standard known as EUREPGAP. A similar protocol was written in Israel known as ECOFRESH.

It should be noted that consumers' demands increase all the time. Farmers must write down the right procedures for their products as well as diligently overseeing the processes by recording and documenting every action and failure in situ. While the EUREPGAP and ECOFRESH are general standards for most producers, they are not enough in all situations. The farmer must clarify the requirements with the wholesaler and incorporate additional requirements or limited adjustments if necessary. It is recommended that this clarification take place before the bid is offered.

Produce handling technology exists all over the world and improves over time as new topics are learned and knowledge is constantly brought up to date. Updating knowledge and learning about problems and their range of adequate solutions is an important and necessary process for ensuring the advantages and reasonable profit margin of the produce so that the farmer can make a good living from it. This work deals mainly with handling produce after harvesting; although it is a large field, we mostly concentrate on control of the surrounding temperature without delving into the more general topics of produce handling.

A number of processes take place when agricultural produce is placed in a refrigerator, or cooled. Some of these processes occur in a relatively short amount of time, while others occur over a long period of time. It is thus incumbent to understand both the transient (short term) and steady state (long term) processes. All of the processes that occur in the product are assessed in this work in terms of climate control and not from a physiological or botanical perspective. Without a doubt, physical processes such as greenhouse climate control affect the product physiologically. Due to my lack of sufficient knowledge of botany, I will not delve into plant tissue processes.

An important topic of agricultural produce treatment is the pathology of diseases that result from the new state of the plant tissue after harvest. One of the most damaging diseases is gray mold. It is caused by the fungi *botrytis cinerea*, and so gray mold disease is referred to as botrytis. As my knowledge of this disease is rather scant, I will characterize it by the climatic conditions that engender its growth.

Many papers have discussed gray mold disease for a long time already, including the presence of factors along the entire production and treatment line that contribute to the disease. The first stop on the line is the plant nursery or greenhouse. The second and third stops are the warehouses or refrigerator. The fourth step is the truck. The fifth stop is the terminal or market. The sixth stop is the airplane or ship, and the seventh stop is a bazaar or retailer.

The papers make it clear that the causes of the gray mold can be found at any stop along the line. Gray mold spores are found everywhere. The greenhouses, warehouses, and cooling rooms cannot be completely cleaned. The most preferable method is thus to inhibit the conditions that engender the sprouting of botrytis spores on the produce. Some of these conditions depend on the regimen of pest control and the durability of the plant tissue, and some depend on the climate control. It is well known that stagnant water resting on the plant or produce endangers it and poses a risk of botrytis infection. Because of this, the greenhouse climate control operator treats freestanding water on the vegetation as dangerous and harmful to the produce.

Identifying moist areas in the greenhouse requires activation of a drying system in order to remove the threat. When dealing with cooling systems, the entire product management cycle must be understood, not just the warehouse refrigerator by itself. The refrigerator has implications on product handling that may potentially be harmful. Proper management of the product throughout the the production and marketing process, including a: greenhouse, warehouse, warehouse refrigerator, truck, terminal, airplane or ship, wholesale repositories, retailer refrigerators, and shelf space will reduce the damage to an insignificant amount.

Deep refrigeration at several stages beyond room temperature will dampen the produce. As is known, any body with a temperature lower than the dew point of the surrounding air will have water condense on its surface in contact with the air. Generally speaking, deep refrigeration of produce lowers its temperature below the dew point of the surrounding air in the warehouse. Produce sorted right out of the refrigerator is generally quite damp, so its dampness is attributed to the refrigerator.

Any refrigerator that works on a compressor, gas, condenser, valve, and evaporator (that draws heat) will dry the produce rather than dampen it. A series of adequate refrigerations will not dampen the produce and will preserve its high quality. Any impingement on the dampness throughout the refrigeration series is dealt with by drying out the produce before it is packaged, so that no water will remain in the sealed package. A thorough understanding of produce handling and careful consideration at each stage of the entire range of solutions to the problems that arise in situ will improve the produce quality, increase its profitability, and reduce the damages resulting from a downgrading in quality, or – worse yet – disqualification.

Another important topic is improvement of the product lane by economizing the labor and reducing costs. A properly designed refrigerator enables, on the one hand, the inserting and removing of an efficient product, and conserving and circulating the air in the refrigerator on the other. Rigorously managing the agricultural production and marketing system will enable the series of post-harvest treatments to be carried out effectively and will ensure long term profitability of this economic sector. In order to attain efficient and optimal streamlining of the product through each stage of post-harvest treatment, all stages must be implemented thoroughly and effectively. An entire area of study, operations research, is dedicated to designing production lines. When a factory is designed, all the functions required to operate are positioned such that the factory will operate in the most efficient manner possible.

In the early 70's, Prof. Chaim Gershoni wrote a book on the topic. One of the chapters of the book is about managing storage rooms. This topic is very related to the topic of operating refrigerators in warehouses. The well known concept FIFO – First In First Out, is the basis for designing a refrigerator. As Prof. Gershoni writes:

> Scrutinizing the problem will lead us to the famous principle of FIFO. From this perspective, we have decided that we must send the merchandise that we received (inserted into the refrigerator), and so the average time required for any detail is minimized

An additional concept in this field is LIFO – Last In First Out. A LIFO procedure is not suited for the storage of produce with a relatively short shelf life. LIFO would likely result in the produce that went in first remaining past its expiration date. Thus, it is the FIFO procedure which is strongly tied in to the management and maintenance of a refrigerator for greenhouse – grown produce. In most cases, spices or flowers are sold in the order that they were harvested. The standard is that the produce inserted into the refrigerator first is marketed first, despite there being exceptions. The concept of FIFO is very relevant, then, to agricultural produce.

In order to operate the refrigerator according to FIFO routine, it must be designed accordingly. Most refrigerators in warehouses in Israel are built for random storage. In the random storage procedure, any produce may be withdrawn from or inserted into the refrigerator at any time. Managing this random procedure requires refrigeration volume up to 40% bigger than that of a FIFO procedure.

Another important factor to take into account is the air in the refrigerator. Overfilling and sealing off air current in the refrigerator wrecks the refrigeration process. Lack of air current inhibits the uniformity of the cooling and endanger the produce. Properly filling the air space inside the refrigerator includes the spaces created between produce, which leaves behind crevices and pockets of air flow in the refrigerator. Efficient air circulation promotes a uniform temperature and moisture distribution. A non-uniform distribution of temperature and moisture result in a variance of shelf life for the produce in the refrigerator.

The warehouse and the entire manufacturing alignment must meet the strictest and most demanding standards. The produce must be free of all pesticide and be transported, as much as possible, in closed spaces and clean, aesthetic structure. The cleanliness and aesthetic appeal of the product and warehouse are an important factor in improving the viability of the agricultural produce. It is unacceptable to package produce in old, dirty warehouses.

New concepts pop up in the day to day life of farmers when dealing with the residue of various pesticide preparation materials. The farmers are required to procure fruit with the pesticide residue below a certain amount. This amount is known as the Maximum Residue Level (M.R.L.). The pesticide residue in fruits, vegetables, and spices are required to be minimized as small as is possible to detect by measuring equipment. This minimal value is called the Limit of Determination (L.O.D.). This threshold is essentially equivalent to zero residue, being that the measuring equipment cannot detect a quantity below a certain amount, and so is considered as zero.

Spice farmers must meet the standards and regulations when building aesthetic warehouses to market quality and healthy spices. As a result, spice growers upgraded the production alignment of spices, including all stages of growth and post-harvest handling. The spices are shipped in roofed carts

or closed spaces. The spice containers or crates are thoroughly rinsed after each shipment. Crates cannot be reused without being thoroughly rinsed. The spices are cut and placed in crates in a controlled manner. Unwanted material cannot be placed in the crates after the harvest. This fastidious admission regulation is an initial, quick, and rough screening. Crates loaded with produce are transported in covered carts. See Figs. 1 and 2.

Illustration 1:

Illustration 2:

The produce is carefully transferred to a warehouse that looks like a polished, clean salon. In Figs. 3 and 4, the reflection can be seen in the shining floor.

Illustration 3:

Illustration 4:

An adequate refrigeration sequence is one where the temperature of the produce decreases along with the surrounding air temperature. It is therefore not recommended to insert the produce into the refrigerator, cool it to 4° C, and transfer it to the warehouse for classification and packaging. This creates a situation where the produce is colder than its surroundings, which can derail the refrigeration sequence. Instead, it is recommended to immediately package the produce upon it entering the warehouse. The warehouse should also be ventilated by an air conditioner in order to cool the produce and moderate the biological processes in it. Air conditioning the warehouse is also important for minimizing the temperature difference between the cooled produce in the refrigerator and the air in the

warehouse.

Good lighting in the warehouse is also important. Painting the walls and ceiling white helps diffuse the light. Instructions to workers should be written clearly. An air conditioner is shown in Figure 5, as well as the proper lighting, white paint finish, stainless tables, and most importantly, the sparkling cleanliness all over.

Illustration 5:

Upgrading the warehouse to meet the regulations, standards, and protocols that were presented earlier induces heavy costs and constant effort on the part of the farmer to ensure the cleanliness which is so important for handling edible produce Cleanliness and hygiene are the order of the day in modern day warehouses, which are gradually becoming pharmacies for all intents and purposes.

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Sources:

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