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POSTHARVEST HANDLING, CURING AND PROCESSING FOR EXPORT QUALITY DATES

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1. INTRODUCTION

Date production in the world was estimated to be about 7.2 million tones of fruit in 2004. The date fruit, which is produced largely in the hot arid region of southern Asia and North Africa, is marketed all over the world as a high value confectionery or fruit, and remains an extremely important subsistence crop in most of the desert regions.

The essence of quality and modern approaches focus on the client's (the consumer) perception of the product, and the behaviour of the product according to definite specifications. There is a progressive improvement in the quality of the product in line with the rising expectations of the clients. This process must be stable, repeatable and capable of producing identical qualities for any length of time.

A farmer's job does not begin and end with producing something. The first agricultural marketing job is to determine accurately in quantitative and qualitative terms just what consumer demands are in time, place and form, and what changes are taking place in those demands over time. The more time, effort and money a firm appends in carefully and completely planning the product which it wants to produce, the less time it is likely to need to spend in selling.

Large amounts of money are being spent to produce the fruit. One should thus put in as much effort as possible to capitalize on the investment through marketing. Marketing is expensive, but to be successful one needs to invest and to be creative. Therefore, to be able to sell date fruit, the packaging should be more attractive, and the contents should be of a higher quality than competitors.

Profitability is also an important measure, making additional investments possible for improvement and growth. The approach is one of delegation of authority to the people who are at the heart of the production process, who may work according to well defined procedures and at the same time use their common sense and act judiciously. Emphasis is placed on cooperation between suppliers and clients in order to make it possible to work with precision, to receive feedback detecting mishaps, and to develop new products.

Emphasis has traditionally been placed on the commodity involved, or the economic functions performed, or the institutions that are involved in performing the various functions. Focusing on these issues separately is important, but the marketing strategy should be to adopt a marketing approach where emphasis is placed on the total system. With this, the entire continuum, from producer to consumer, becomes the focal point.

While describing the process which the fruit undergoes in the packinghouse, from the moment of entry until the product is ready for marketing, emphasis is given to the various aspects of quality control, mandatory in high quality products.

During the last 30 years or so, several changes in date harvesting, packing, processing and marketing have taken place. Perhaps one of the most striking trends in a number of date producing countries of the Old World has been that, under the influence of newly acquired oil wealth, date cultivation, packing and processing could be modernized, in spite of a tendency of decreasing importance of the date as a staple food resulting from the same welfare increase. The highly traditional nature and close relationship of the date grower and his crop has undoubtedly also played a role in preventing a decline in date production. New outlets for at least part of the crop were found through better handling and processing methods to cater for more sophisticated emerging markets. Modern technologies, mostly imported, sometimes adapted made it possible to achieve more uniformity and higher quality standards.

2. DATES QUALITY

- The dates packing pattern can be split into three segments:
- **Premium segment or fancy and gifts segment:** This is the high price segment, representing dates of popular and expensive varieties, in luxurious packaging as fancy gifts. It constitutes a small share of the market products with an estimated volume of 200 tons. Prestigious packs, both modern and traditional, of various size and styles, are sold in some outlets like UAE.
- **Medium priced segment:** This is of two types, the first sub-segment consist of dates packed in small plastic or paper cartons, loose or pressed, pitted and vacuumed, and the weight ranges from 250 g to 3 kg, usually for domestic markets or export. This segment utilizes 700-900 tones per year. The second sub-segment is the main bulk 10-25 kg, selected loose dates, fumigated, washed, graded and packed in cartons. It covers a big range of varieties, the prices are cheaper, and the fruit usually sold to distribution companies or traders for local market and export. The size of the sub-segment varies from 20,000 to 25,000 tones per year. The prices are reasonable and affected by the immediate market prices.
- **The third segment** consists of the normal dates of mostly Sayer and second and third grades, packed in tissue or plastic sacks, or woven sacks of palm leaf, mainly for livestock and some for export to Asian countries. This fruit is normally sold at very low prices to traders by the farmers.

The genetic differences and growth conditions of dates result in wide variations in final appearance and different quality levels. Moreover, quite apart from the inherent properties, fruit quality is also determined by external influences, for example, degree of insect infestation, defects (broken skins, sunburn, blemishes, shriveling), presence of foreign matter (seeds, dust, debris), pesticide residues, mould, yeast and decay.

It is necessary to note all these factors when drawing up a “ dates quality profile”, which will also include an evaluation of colors, shape, size, taste, texture, pits, calyxes, as well as consideration of uniformity in color, size, moisture, sugar, acidity, fiber content and other constituents, where desired.

3. DATE POST-HARVEST TECHNOLOGY TRENDS

During the last two decades, the food industry, date producers and marketing policy markers have taken cognizance of the projected trends and considered the recommendations published by various food and date economists.

The recommendations have stressed the necessity to enlarge the date and date products share in the international trade market, taking into account the significance of the World Trade Organization (WTO) and of globalization for the international trade in dates.

The following trends have been or will be noted and measures implemented to improve the quality of date products and increase returns to farmers and processors.

Trends in Production Harvesting, Handling and Storage

- Replacing methyl bromide in fumigation with a physical method, such as heat, vacuum or radiation in response to international recommendations (Montreal Protocol Action, 1977).
- Application of mechanical ladders and special heavy duty baskets for harvesting and transportation.
- Using closed dehydration chambers to dry *Rutab* stag dates in production areas to improve the quality of raw dates.
- Establishment of multipurpose cold storage for dates controlled temperature refrigeration and freezing with automatic humidity controls.
- Establishment of new date receiving centers throughout the production areas in the country, equipped with large loading areas and facilities for receiving dates – initial grading by conveyers and weighing system – and for the preparation stage, in addition to fumigation tunnels and multipurpose cold storages.

Date production technology can be divided into two main categories:

The process that keeps the dates intact and unaltered, by packing the whole dates, with original shape, color, identical taste and flavor; and the transmutation industry of dates through physical methods.

4. DATES CONDITIONING: (HYDRATION, CURING, DEHYDRATION)

Hydration, Curing and Dehydration

The aim of dehydration and hydration is to improve the quality of the fruit, to produce uniform fruit with regard to its moisture, and to extend its durability during storage and marketing.

These processes are carried out by artificial means in the packing house when hydration or dehydration is not carried out earlier, during the treatment of the fruit in the field. When treated in the packing house, the fruit is dehydrated or hydrated after it has been stored or washed, when the moisture can range from 10% in very dry fruit to 30-45% in fruit at the stage of curing (*Rutab*). Of course, the moisture of the fruit also depends on the variety, the region and the weather at the time of harvesting.

Hydration

Some of the varieties (for example *Amri* and *Zahidi*) have a dry and hard texture in regions where during the ripening of the fruit (the transition from *Khatal* to *Rutab* and from *Rutab* to *Tamar*), the temperature is high and moisture is low. In this situation moisture must be increased by hydration. This is a process of fruit saturation with water or steam, while ensuring the appropriate temperature in order to create optimal conditions for enzymatic activity, which will cause the fruit to soften. This softening is often accompanied by a rise in moisture to a level that can endanger the fruit by exposing its microbiological elements (when moisture reaches over 20% and EMC over 65%) The appropriate hydration process depends on how long the dates have been exposed to these conditions.

Curing

An activity similar to hydration, by integration of temperature and moisture, is carried out when some of the dates are unripe, *Khalal*, or when a stage has been “skipped”.

Unripe fruit enters the packing house for two reasons:

- In cold regions (for example *Eleche* in Spain) where the fruit does not ripen under nature conditions or rains may threaten the fruit.
- When harvested in the usual way (*Khalal*).

“Skipping a stage”: This situation arises when the transition from *Khalal* to *Tamar* is very far (in hot regions) and some of the fruit are not ripe while the fruit is already shriveling and at *Tamar* stage. Such dates (usually of the *Medjool* variety) have white shoulders or are natural white –these are the parts of the fruit in a light unripe state against a light brown background

Tamar. Most of the Deglet Noor in California is harvested when it is very dry and hard, only hydration treatment bring it to moisture of 23 to 25% and make it suitable for marketing (to meet consumers demands).

Dehydration

Dehydration is undertaken when the moisture of the fruit higher than planned (with respect market needs). In order to preserve the fruit for any length of time (without refrigeration), it is important to decrease the moisture to below 20% (depending on the variety). At a moist percentage of 15% to 20% varieties such as Khadrawy, Halawy and Medjool can be treated for a long time, unharmed by microbiological processes (such as fermentation, souring or emergence of mould). If the moisture percentage is too low, the fruit will be hard to eat for some of the consumers (mainly on the European market). Decreasing moisture also reduces the risk of sugar crystallization.

It is important to ensure moisture uniformity. Fruit at an undesirable level of moisture will be spoiled by microbial activity. This phenomenon is found in “Juicy Medjool” and Deglet Noor on branches, when packed with a high level of moisture. First alcohol fermentation takes place as a result of the yeast activity, and later a process of souring, caused by the activity of various kinds of lactobacilli. The following factors influence appropriate dehydration temperature, moisture, the speed of airflow, the uniformity of the above varies and the length of dehydration time.

Dehydration is carried out in special chambers. These chambers control the entry and flow of hot air, to ensure the appropriate moisture level. All these conditions must preserve the question of the fruit, especially with regard to skin separation. The temperature must not rise above in order to prevent “the burning of sugars” – caramelisation. High temperatures will also the fruit to darken. Different temperatures suit different date varieties: Hillawi 55°C, Deglet Noor and Medjool 55°C.

Quality control during Hydration and Dehydrations

The amount of water in the fruit exert a great influence on quality and shelf life, mandatory to have a constant follow-up on the product by various means of testing. This ensures the client receives fruit of the quality he or she requires, both with regard softness and to its moisture, which must not be too high. The latter prevents harmful microbiological processes or the rise of sugars.

An important aspects of quality control is the documentation of the findings, making it possible to check the amount of moisture during various processes and facilities the traceability of the product, which is important for the detection of mishaps during the various stages of production.

5. DATES PROCESSING AND PACKING

Process keeping dates Intact and Unaltered:

This process is adopted by the packing industry. The process involves fumigation, grading, cooling, sorting washing and dehydration. Packing takes place in a variety of ways: according to size, different styles, loose, lined, vacuumed, pressed, pitted, glazed or stuffed with nuts or sweets and chocolate, mainly packing plants for bulk production of many types of dates and date products, for both local and export markets. Most listed packinghouses or processing plants are equipped with suitable machine of fumigation, handling, grading, sorting, washing and dehydration (tunnels or chambers), pitting machines, automatic filling machines, vacuum plastic packing, hydraulic pressing and shrink wrapping equipment, as well as packing labeling, strapping, printing and carton closing systems.

Some of the salient technical aspects of this progress are the following

- Increased use of plastic boxes and crates for improved field handling and storage of dates.
- Use of vibrating tables and conveyors during grading for better inspection and bulk packing of dates by vibration instead of pressing.

- Increased use of vacuum fumigation and the use phosphine, the latter also during transit.
- Continued consideration for the introduction of insect control by irradiation.
- Regulation of moisture content (hydration, dehydration) in the packing plants for better control on product quality and uniformity.
- An emerging trend of marketing Khalal and Rutab under refrigerated conditions.
- Increased automation in date packing plant operations
- Introduction of automatic filling of bas and thermoform pack and packing under vacuum and nitrogen gas.
- Increased use of mechanized pitting and stuffing of dates.

Sorting

In order to ensure that the results of the sorting are appropriate to the clients requirements, it is important to provide the sorters with precise, unambiguous definitions of the defects of the fruit they are to transfer to another category. The following defects can be identified in date fruits.

1. *Defects stemming from microbiological processes:* Fermentation (Alcoholic), resulting from the activity of yeast, souring resulting from *Lactobacilli*, *Acetobacteri* or *Aspergillus niger*, a fungus which creates a black promycelium which fills up the stone cavity. These types of defects cannot be tolerated, such fruit must not reach the customer, nor can it serve as raw material for products. These defect may be due to inappropriate conditions during storage (for example wet fruit without refrigeration) or arise while the fruit it still in the field.
2. *Defect caused by pests:* Resulting from the activity of insect and various mites. The most common are the remains of various moths, sour bugs and mites. Some of these pests have signs of nibbling inside the fruit some spoil the look of the skin. The tolerance for these defects differs according to various standards; going up to 4% in all cases there must be no live insects inside the package. Defects caused by birds, mice, bats or other rodents (mainly signs of nibbling on the outside) are often found on fruit grown without being covered by a net or paper; or stored in an inappropriate conditions. Such fruit must be removed. These pests may leave remains of feathers, excrement of mice or birds, which sticks to the fruit and may cause microbiological contamination.
3. *Mechanical defects:* as a result of fruit being crushed while wet after harvesting, or grazed or scraped during the period of growth, leaves scars on the fruit. Sometimes the fruit is so badly spoiled by the earth and mud that washing does not clean it.
4. *Physiological defects:*
 - Un-pollinated fruit that reaches in an unripe state (its color depending on the variety).
 - Shriveled and dry dates, usually dates which have been detached from the spikelet while still unripe.
 - Defects caused by water stress (excess or shortage), which may lead to checking (in Barhee) or black nose.

Some defects will appear more frequently in certain species. The workers must become familiar with them. This information can be provided by drawings of the defects and there must be guidance during the sorting and control of its results.

Quality control during sorting

Control and sampling is done by laboratory workers. Control must ensure that the demands of the sorting instructions and definitions have been respected. Testing for internal defects is done by cutting the fruit with a knife and checking the internal cavity. Sampling is carried out according to procedures defining the frequency of sampling and the size of the sample. The results are written on a specific form and the forms are kept for the follow-up according to the demands of clients.

The clients are the buyers whose quality system demands that the suppliers have authorization, either via acknowledged certifying body or according to the client's specification, which includes documented traceability.

Grading/Selecting

This is usually done together with the sorting, on the same installation, thus avoiding the need to transfer to a different storage (at the intermediate stages) and additional pouring of fruit onto the conveyer belt. Many attempts have been made to make this process more efficient by automatic grading, but, owing to the complexity of the processes and the difficulty of imitating human senses, especially that of sight, no solution has yet been found for sorting grading "without human hands".

The aim of grading is to produce packed fruit which is uniform in size, shape, colour, texture, moisture and skin separation. For each variety the standards are different. The client's requirements can also determine the criteria during the grading:

Size sorting can be done in one or two stages.

Stage 1

Grade A:	Perfect fruit
Grade B:	Fruit with skin separation
Grade C:	fruit for pitting and for industrial use
Grade D:	Rotten and damaged fruit.

Stage 2:

The second stage of sorting is to sort the grade A product to size (jumbo, large and medium).

This is particularly important for varieties with large fruit such as Medjool or Amri. Medjool the sizes have been defined according to the weight of the fruit (moisture content fixed at 16% - 19%).

Jumbo:	more than 23g.
Large:	18g to 23g and
Medium:	15-18g.

Use of Machinery and Processing Movement

- Rolling cylinders with movement – controlled spacing devices for efficient size grading of dates according to size.
- Moving vibrators for improvement in date sorting.
- Spiral roller screens with holes for high capacity paste making to produce soft paste with less fiber content.
- New technology, such as rolling counteract grinders to produce low moisture content and high fiber paste.
- Fully automatic adjustment for date pitting machines.
- Fully automatic multi and fully programmed pressing machines.
- Large controlled automatic vibrator filling machines for filling dates.
- Rolls or specific plastic bags or carton containers for various sizes and weight of vacuum or non-vacuum-packed fruit.
- Three stages of filtration pad-press filters followed by centrifuged decanting and newly developed micro-filter to produce very highly filtered and clear juice.
- Triple stage syrup, condensation and vacuumed evaporators.
- Antiseptic technology to get high quality shelf life bulk syrup.

Product Development and Marketing

- Glazing of arranged, stuffed and loose dates.
- Chocolate enrobed whole dates and paste with or without nut stuffing.
- Wafer-type dates and paste bars or sandwich – type dates, with or without nuts.
- Transmutation products from dates such as vinegar, medical and industrial alcohol, liquid sugars, colorless date syrup, powdered date sugars and so forth.

- Utilization of byproducts, such as pits, fiber, leaves, date pulp, date cake, cull dates (calyx cupules) to produce feed cubes/pellets, ground mix feed and concentrated complete feed mead.
- Using different triple lines of packaging materials to maintain the quality of the dates, including aluminum foil.
- Using Pt. PE-PP packing materials together in specific packs.
- Self laminating food grade PE inside the bulk container cartons.
- Full detailed labeling information including variety certificates, hygiene and nutrition facts.
- Using controlled temperature containers for long distance shipments.
- Exhibitions of different varieties of dates using traditional plates, bowls and trays made from palm leaves, woven with narrow mid ribs and in different shapes exhibiting heritage/historical landmarks.

6. MAJOR PROBLEMS AND CONSTRAINTS FACING PACKERS AND PROCESSORS

High percentage of low – grade date varieties regarding size, taste, poor flesh color and flaking texture, creating problems in packing and processing, in addition to increasing processing costs and affecting market price.

The majority of dates received by collecting centers (Sayer) are not identified. The fact that they don't have a well – known name is considered an obstacle in determining the treatment of the dates. This results in the lowering of the market price.

High moisture level of some dates, especially from the coastal and northeastern production areas, is creating a problem due to rapid deterioration and fermentation. Problems are also faced with conveyors, raising the cost of dehydration.

High degree of farm infestation, particularly late in the seasons, with varieties such as Fardh, Lulu and Jabri. There is also re-infestation during storage, loading and distribution to retail markets, which affects the quality of the date. The major infestation in the UAE is caused by:

- *Ephestia spp.* (*E. cautella* or tropical warehouse moth infests all types and varieties immediately after harvest, up to 80% of the yield).
- *Oryzaphles surinamenies* (grain saw beetles infesting the dates after harvest and also after storage, up to 10% of the yield).
- *Vespa orientalis* (affecting dates at Rutab stage).
- High cost of date production, especially of commercial varieties, which affect the input cost for some packinghouse.
- High cost of the machinery and spare parts.
- High cost of labor and packing materials
- Lack of international standards specifications for some date products.
- Packing material of poor quality, which does not suit the imported machinery.

Quality profile

So far, the inherent constituents of the date have been reviewed, which each in its own way takes part in the formation of the fruit. Because of genetic differences and growth conditions dates show, perhaps more than other fruits, a wide variety in their final appearance and quality as perceived by man. Moreover, fruit quality, apart from these inherent properties, is also determined by influences from outside, classified as degree of insect infestation, defects, presence of foreign matter (sand, dust, debris and the like) and pesticide residue.

To draw up a date quality profile will therefore involve an evaluation of

- Colour, shape, size, taste, texture, pit/date ratio and uniformity in colour and size of the fruit.
- Moisture, sugar and fibre content and other constituents if desired.
- Defects of the fruits, which may include discolouration, broken skin, sunburn, blemishes, shrivel, deformity, etc.
- Presence of insect infestation, foreign matter, pesticide residues, mould and decay.

Some of these quality factors are subjective and their qualification is linked to individual preferences. For instance, some people may prefer the soft, moist dates that “melt” in the mouth, whilst others opt for a more chewy fruit. On insect infestation, foreign matter and pesticide residues there is no doubt, they should be eliminated or reduced to the minimum.

To arrive at acceptable and applicable quality standards for dates the main characteristics, especially the non- desirable ones, have to be quantified preferably in figures, by which the ultimate grade the date will be established. A number of countries have formulated and applied date standards at the national level (e.g. USA, Canada, Israel, Algeria, Tunisia and Oman) both for locally produced and imported dates. In an effort to arrive at global standards for dates the Codex Alimentarius Commission of the Joint FAO/WHO Food Standards Programme formulaed a proposal for date standards intended to be the basis for world – wide application subject to the acceptance by governments. Also the Economic Commission for Europe of the UN Economic and Social Council have proposed “Recommendations concerning the marketing and commercial quality control of whole dates moving in trade between and to European countries, which have been incorporated in the Compendium of Applicable Standards issued by the Organization for Economic Cooperation and Development (OECD).

7. RESEARCH AND DEVELOPMENT POST HARVEST CHALLENGES:

The date production and post harvest technology is facing many technical and horticultural challenges:

- Flaking/skinning off of some commercial varieties such.
- Small size of some varieties, of dates
- Leathering of large varieties and light density in fruits.
- Irregularity in maturation, especially on the same bunch or at Rutab stage.
- Most of the clones and varieties are not classified or identified, or have different named.
- Need for improved methods to dehydrate or hydrate dates.
- Need to overcome the stickiness character of some dates.
- Research into the best conditions for date storage, according to type, variety and method of processing.
- Research and studies to produce animal feed using dates and residues.
- More studies on Rutab storage technology and marketing.
- Research suitable packaging materials for various products.
- Preparing standards for new varieties of dates.
- Categorization of raw dates according to variety for local and export market.
- Research on conditions atmosphere.
- Research on enzyme inhibition methods.
- Research on packaging materials
- Studies on Post harvest technologies cost.
- Research on Dates flavour.
- Studies on best grading technology

8. RECOMMENDATIONS

- Starting at national level to improve the quality of present dates, by screening of varieties, old trees, males, neglected trees and so forth. Replacement with good varieties through the establishment of a long term program and definite projects to be carried out by research centers, agriculture entities, laboratories, universities, private sector and propagation companies, establishment of packinghouses and processing plants in addition to companies to research this goal.
- Strengthening the extension and plant protection department services to adopt the best methods and knowledge to deal with palm trees, from planting to harvesting.

- Increasing the number of receiving centers for dates all over the production areas, equipped with facilities for unloading, weighing equipment, fumigation, cold storage, loading and transportation.
- Application of various tests, trials and observation to overcome some of the most important post harvest technology problems.
- Establishment of germplasm bank of males and females for quality improvements programs.

9. GENERAL RECOMMENDATIONS

- There should be strong coordination among date manufacturers to solve the problems facing their interests.
- There should be strategic plans to export to countries such as the US, Canada, Australia, Japan and Europe.
- Plants should operate at full capacity to minimize overhead costs.
- Gain substantial market share by overcoming fragmented competition of the cottage industry.
- Segmentations of products to cover wide range of packaging. Each modern plant should initiate market and consumer research.
- Support fresh dates marketing at Biser and Rutab stage.
- There should be national campaign for promotion of dates and date products for marketing via educational, nutritional, and food preparation entities.
- Innovation for new product development based on traditional UAE dishes.
- Incorporation of dates and their byproducts – syrup, chopped dates, post in breakfast meals.
- Cooperation with newly established Date Palm Global Network (DPGN) programs to carry on research, studies and exchange of dates post harvest information.
- There should be a standing commission for research and technology to establish a development plan at national level.
- It is high advisable to study the possibility of having an independent entity on global level for date palms and date production, processing and marketing.