

Maturity, Quality and Marketing of Fruits and Vegetables

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ABSTRACT

Maturity at harvest is one of the main factors determining the quality of a product. Postharvest technologies deal with separation, sampling, sizing, sorting, grading and marketing operations. These postharvest handling procedures are most important as they may either protect the quality or ruin much that was achieved up to this stage. The fruit and vegetable industry is unique. Dealers handle a product that is very perishable. A one or two day delay in marketing can mean the difference between profit and loss. This paper examines maturity indices for fruits and vegetables, quality of fresh horticultural commodities and marketing of mature and quality agricultural produce. Developing countries need to develop maturity indices, quality standards and organize on governmental or cooperative levels to penetrate the marketing systems of the rich nations.

Keywords: Maturity, Quality, Marketing, Fruits, Vegetables.

1. INTRODUCTION

Elazar (2004) states that fresh produce world production represents 9% international trade, 30% industry and 61% domestic markets. Changing trends in agricultural produce marketing has to do with consumer preference, health consciousness, marketing channels, environmental friendliness, organic agriculture, biotechnology (GMO), e-commerce, EUREPGAP, prepared fruits and vegetables, preserving consumer's trust, avoiding chemicals as much as possible (integrated agriculture), caring for the worker, health, security and welfare (Elazar, 2004). Marketing research function under these circumstances operates a marketing information system and dissemination of the information, produce studies and reports concerning developments in the export markets including evaluation and forecasts; seek, observe, identify and analyze marketing opportunities and marketing threats; provide marketing advice and guidance to Research and Development activities and provide information and the advice to the decision making by policy makers and the export organizations. Information for decision-making should be available and accessible, concise and processed to a form in which the decision maker can use it fast and easy. Data is raw facts and figures, information is organized data and knowledge is information analyzed and understood, ready to be applied (Kalman, 2004).

2. MATURITY INDICES FOR FRUITS AND VEGETABLES

Maturity is the stage of development at which the produce has completed its natural growth and is ready for harvest. It is that stage of development, which ensures proper ripening. The horticultural (commercial) maturation, however, is related to the utilization purposes, for example: tomatoes are regarded as mature for fresh market consumption when they are "mature green" in the USA, but in Israel they must be at least pink in order to be mature for harvest. However, for the canning industry, tomato fruit is mature only when it is dark red, as the red color is a most important feature of the product. Maturity also depends on the part of the plant, which is being consumed. Because of the great differences between commodities, the development of specific indices of maturity for each commodity is required (Fallik and Aharoni, 2004). The reason for harvesting a commodity as early as possible is usually the high prices fetched at the beginning of the harvesting season, and also the desire to divide the total yield over a longer marketing period in order not to flood the markets and thus reduce the prices at the peak of the season. As the maturity at harvest determines the quality, growers groups as well as government authorities, who want to protect the reputation of their produce and the public, may decide on some minimum requirements for maturity acceptable for a given commodity. For example, it is permissible to harvest avocado fruit of a certain variety only after it has at least 8% oil in its flesh. All these considerations are really marketing policies of the producers. For planning purposes of labor and equipment, it is desirable to predict the anticipated time of maturation of commodities. It is therefore necessary to find objective and reliable methods for prediction. This can be achieved by establishing, over the course of several seasons, correlations between parameters, which are related to maturation and ripening, and time of the season (Fallik and Aharoni, 2004). Parameters which are considered for the determination of maturity indices are: chronological age (elapsed days from bloom to harvest), size, shape, surface characteristics, color, firmness, compositional factors (soluble solids), development of abscission layers, surface morphology, solidity, tenderness, sugars, starch presence, sugar-to-acid ratio, oil content, and more. In recent years much work has been conducted on developing nondestructive methods for the measurement of fruit and vegetable characteristics, using principles of NMR, X-rays, sonic and ultrasonic waves, delayed light emission, and light reflectance and Near Infrared. Maturity indices must be set for each region and variety. International regulations have been drawn up for some commodities, in order to protect the consumer from imports of immature commodities (Fallik and Aharoni, 2004).

3. QUALITY OF FRESH HORTICULTURAL COMMODITIES

Quality of fresh horticultural commodities is a combination of characteristics, attributes and properties that give the commodity value for food (fruit and vegetables) and enjoyment (flowers). Different operators have different concerns (Hickson, 2004). Growers are concerned with the crops resistance to pests and diseases; Wholesalers - long shelf life; Retailers - freshness, external appearance; Consumers - taste, appearance, nutritional value, safety; Food marketers - internal quality, phytosanitary condition. Quality Standards are a tool to define and measure quality. They provide a means to measure the "value" of agricultural products. Types of Quality Standards include National Standards - fixed in national laws and regulations, International Standards - fixed in international agreements and Industry Standards - fixed by and

within agreements between members of an industry sector. Quality Standards provide a common language for traders along the marketing chain, help operators to correctly label products according to their quality, provide a basis for payments according to quality; prices, quantities, market reporting and help to settle claims and disputes between trading parties.

3.1 Quality Parameters and Evaluation Methods

- Appearance (visual) - size, weight, dimensions, shape, color, gloss and defects. Evaluation methods include color charts, shape charts, defects charts (mechanical, physiological, pests, diseases), size gauge, rulers and scales. These are mostly non-destructive methods.
- Texture (feel) – The parameters and evaluation methods include firmness or succulence (pressure testers, penetrometers), crispness (sensory evaluation techniques), juiciness (juice extractor), mealiness or grittiness (sensory evaluation) and toughness or fibrousness (texture testing, chemical analysis). These methods may be destructive or non-destructive; scientific/objective or subjective.
- Flavor (taste and smell) - sweetness (sugar), sourness (acid), astringency, bitterness, aroma (smell), bad flavors or smells
- Nutritional value – carbohydrates, proteins, lipids, vitamins and minerals

Flavor and nutritional value parameters are called internal quality parameters. Evaluation methods include sugar test (refractometer), acidity test (titration), tannins test (FeCl_3) and fats test (oven/microwave). These methods are destructive and objective. Safety Parameters are not covered by Quality Standards. They are covered by other national, international and industry standards. Safety issues are naturally occurring toxicants, contaminants (chemical residues), mycotoxins and bacterial toxins and microbial contamination. In the production of Quality Standards, stakeholders include Marketing Boards, Regulatory Authorities, Farmers/ Producers, Packaging Industry, Wholesalers/Retailers, Exporters/Importers, Researchers and Consumers.

3.2 Non-Destructive Testing (NDT) for Quality Evaluation

Several methods for non-destructive quality evaluation of agricultural products have been thoroughly investigated. Each method is based on measuring a given physical property. The effectiveness depends on the correlation between the measured physical property and the quality factor of interest. However, through use of computers and advanced data processing techniques the effects of extraneous factors can be minimized and quality evaluation improved (Fallik and Aharoni, 2004). Table 1 describes the different techniques related to different quality features.

3.3 Guidelines for Developing Quality Standards

- Demonstration of need and support by the industry
- Form a working group
- Study of quality parameters
- Study of market requirements
- Consultation with all parties concerned
- Development of a draft proposal
- Approval by official working group
- Publication

Table 1: Physical parameter measurable by non-destructive sensing methods.

NDT Sensing Methods	Appearance						Internal/Texture		
	Color	Size	Shape	Cracks	Texture	Bruises	Firmness	Cracks	Bruises
Vision	+	+	+	+	+	+			
Vibrations							+		
Impact							+		
Acoustics							+	+	+
Electrical									
RF Impedance									
X-Ray								+	+
NMR			+						
NIR									
Gas Sniffer									

NDT Sensing Methods	Flavor Parameters					Miscellaneous Parameters				
	Sweetness	Acidity	Oil	Protein	Astringency	Volatiles	Moisture	Density	Weight	Ripeness
Vision										+
Vibrations									+	+
Impact									+	+
Acoustics	+		+					+		+
Electrical							+			
RF							+			
Impedance										
X-Ray										
NMR	+		+	+						
NIR	+	+	+	+	+		+			
Gas Sniffer						+				+

Source: Fallik and Aharoni (2004)

3.4 UNECE Standard for Citrus Fruit (UNECE, 2002)

3.4.1 Definition of Produce

This standard applies to the following fruit, classified as “citrus fruit”, to be supplied fresh to the consumer, citrus fruit for industrial processing being excluded: Lemons of varieties (cultivars) grown from the species *Citrus limon* (L.) Burm f.,... Limes of varieties... Mandarines... Oranges... Grapefruits... Pummelos...

3.4.2 Provisions Concerning Quality

Minimum requirements (the fruit will be intact, clean and dry; free of damage or signs thereof; free of diseases, pests or signs thereof; ripe, fresh, tasty and fragrant); maturity requirements (the fruit will have minimum % juice content; minimum sugar content – TSS and specific coloring) and classification (extra class – superior quality from every aspect: shape, coloring, skin texture; free from all defects, an excellent example of the variety; Class I – characteristic of the variety, of good quality, some slight healed defects are allowed; Class II – characteristic of the variety, of satisfactory quality, some visual and textural defects may be allowed).

3.4.3 Provisions Concerning Sizing

Minimum size (e.g., fruits of less than the following minimum sizes are excluded: lemons – 45mm, Limes – 42mm, Clementines – 35mm, Mandarin varieties and their hybrids – 45mm, oranges – 53mm, grapefruit and its hybrids – 70mm, Pummelos – 110mm) size scales (size code “4” for lemons with 58-67 diameter in mm, oranges 77-88, grapefruits 88-102; size code “5”

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lemons 53-62, oranges 73-84, grapefruits 84-97) and uniformity (the maximum difference between fruit in the same package in mm cannot exceed, for example in oranges, as follows: at size code 0-2, 11mm, at size code 3-6, 9mm and at size code 7-13, 7mm).

3.4.4 Provisions Concerning Tolerances

Quality tolerances (5% for extra class and 10% for classes I and II) and size tolerances (10% for all classes not withstanding the minimum).

3.4.5 Provisions Concerning Presentation

Uniformity (each package/bulk must be uniform and contain only Citrus fruit of the same origin, the same variety or commercial type, the same size, appreciably of the same degree of ripeness), packaging (the package must be new, clean and of quality to avoid damages and to protect the produce properly and wrapped fruit - paper must be thin, dry and new) and presentation (the citrus fruit may be presented arranged in regular layers in packages or in bulk bins, which is allowed only in Class I and II).

3.4.6 Provisions Concerning Marking

Each package must bear the following particulars, clearly and legibly marked. For citrus fruit transported in bulk, these particulars must appear on documents accompanying the goods: Identification, nature of produce, origin of produce, commercial specifications and official control mark (optional).

3.5 Grade Standards and Enforcement

Grade standards define the level of quality of a commodity. Such standards are important for produce marketing on the local as well as international markets. The standards are a common language, which has been agreed upon among all those involved in the marketing process. It is easier to prepare and label the produce for the markets when the standards are clear. It enables giving rewards for quality and thus provides an incentive to strive for better quality. Should a dispute arise, it would be easily resolved with a clear and simple standard. The problem is that in spite of the efforts to have a single standard, many exist and there are differences between them. In every country there must be a government authority, which has the task of preparing the standards and the means to enforce them. The OECD (Organization for Economic Co-operation and Development) standards are the most commonly used ones internationally, and they are mandatory in European countries (EEC). ISO (International Standard Organization) and the US standards are similar to those of the OECD, but not identical. The international standards for fruits and vegetables are categorized into three classes: Extra class = superior quality; Class I = good quality; Class II = marketable. Plant Protection and Inspection Services (PPIS) of the Israeli Ministry of Agriculture and Rural Development is the enforcement authority of the Ministry of Agriculture and Rural Development in the field of plant health, safety and quality. In Israel, all fresh produce (propagation material, flowers, herbs, fruit, vegetables) destined for export is subject to quality control by PPIS. The Perishable Agricultural Commodities Act (PACA) of 1930, in the USA requires buyers and sellers of fresh and frozen fruits and vegetables to live up to the terms of their contracts and provides informal and formal procedures to resolve disputes outside the civil court system (PACA, 2002). In Nigeria, the Standards Organization of

Nigeria (SON) does not seem to concern itself with fresh fruits and vegetables and other products of the farming business.

4. MARKETING OF MATURE AND QUALITY FRUITS AND VEGETABLES

Marketing is simply the right product at the right place at the right time at the right price. The success of any business based on the ability to increase the number of its satisfied customers. The modern marketing plan is based on the concept that directs the farmer's business to focus their efforts to identify the wishes and the needs of the customers and to make them satisfied customers, by fulfilling their needs while making profit. The customer is important in any marketing concept. The policy and the activity of the business must be directed to fulfill the needs and the wishes of the customer. In applying the marketing concept, there must be

- Market survey (identify the needs and the wishes of the customer through collection of market information).
- Marketing strategy (identify your relative advantages)
- The target market (identify the market segment) - geographical segment, product variation segment and customer's variation segment.
- The marketing blend (decide how to satisfy the needs and the wishes of the customer).

The components of the marketing blend are the product or the service, advertisement sales and promotion, cost accounting (price policy) and distribution channels - traders, commission agents, dealers, retailers, etc.

4.1 Setting up a Marketing Plan

Setting up a marketing plan involves:

- Collection of information and target market analysis (What is the area border of your market? What is the trend in your target market? What are the main problems? What are your opportunities? What are the sales potential in monetary terms and percentage (%)? Who are the main competitors? Who are the potential customers? Why the potential customers will buy your product or service? Who are your main potential customers?)
- Setting up marketing objectives. The objectives must be defined quantitatively and time schedule must be established: Sales extent (scheduled), market segment (market %), distribution (%), differentiation - high quality/low price and product or service awareness (measured by %).
- Setting up marketing strategy: The product or service, cost accounting (the total cost, competitors price and the profit), advertisement and sales promotion (the advertisement must emphasize the advantage your product will bring to the customer and its recommended to establish an annual advertisement budget), salesman management (motivate the salesman by money remuneration, public compliments and training and additional studies), packing material, distribution setup (your own or hired), distributors and dealers (preference of your product) and public relations (mainly by the media).

In setting up price policy, the following must be taken into consideration: Low prices and low profit at the first stage of the business activity; High price at the beginning with new and monopolistic product; Reduction of prices as a reaction to strong competitor low prices; Increasing the prices as a reaction to strong competitor high prices, but still be cheaper.

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Marketing performance evaluation must be done quarterly: Is the activity of the business carried out, while satisfying the needs and the wishes of the customers? Does the workers satisfy the customers, causing them to return? Is it easy for the customer to find what he needs. Is the price competitive? Other activities in marketing includes setting up marketing budget, setting up timetable (responsibilities and timetable for every activity in every stage of the plan) and setting up control and supervision (Who is responsible for this activity? What he must do? When this activity will be carried out? Where it will be carried out? Why each activity will be carried out? How each activity will be carried out?)

4.2 Product Orientation versus Market Orientation

Product orientation (what grows best): What? - local custom; When? - climate, social or religious restrictions; How? - input of technology, resources. Market Orientation (What sells best): Local market - product orientation; Outside markets - regional, national, international; product stabilization - packing systems (for long transport and storage); transport systems (cold chain, ripening); disinfecting (phytosanitary regulations); stabilization (post harvest various treatments); fast distribution in countries of destination; sales and pricing options - buyer pays FOB (low risk for supplier), buyer pays CIF (low risk for buyer, high revenue for supplier), buyer pays “best sales” (less commission - higher risk for the supplier, works through board systems).

4.3 Vegetables Marketing and Promotion Concept

- The Goals: Improving the quality of the local production as import prevention, creating differentiation between your products and the competitors products, increasing the consumption of the product by existing and new consumers.
- Purchase and consumption behavior: Dominance of the women - needs definitions and way of consumption; family purchase - chain stores; development of shopping centers -purchase combined with leisure; social-economical gap - creating differentiation in consumption, convenience and price consumers; movement from buying in traditional chain stores to cheap private chains and stores; giant stores entrances into cities - increasing the buying frequency; wholesalers market is the meeting point between the buyer and sellers; a multitude of wholesalers markets can cause damage of information deficiency and lack of balance between the markets.
- Vegetables: Most of them are basic products in every house. Some used for special consumption like cooking, additives, decoration etc; vegetables preference by average family (salad vegetables - tomato, cucumber, lettuce, pepper, radish, spring onion; special vegetables - cherry tomatoes, green herbs, sprouts, mushrooms; basic food - potatoes, onion, carrots; other vegetables – cooking); vegetables considered as a fresh every day food like bread and milk; vegetables considered as healthy and tasty; and the volume of fresh vegetables consumption (decreases as the family income and education increase).

4.4 Consumer's Profile

Low class - market purchasers, big amount, importance of price. Middle class - chain stores purchasers, impulsive buyers, conserved product buyers, frozen products, importance of quality; High class - exclusive shops purchasers, special products, importance to top quality and taste, colour, smell, shape, cleanliness and appearance; Health conscience buyers - vegetables as a

leading product, quality and biological products and selective; The efficient buyers - convenient products, frozen products, fresh products that is convenient.

4.5 Target Customers

Housewives are the main target; special customers - like health conscience, sportsman, and sick people; nutrition advisers - leaders in food business; public market - chefs, kitchen managers, hospitals, old age homes, hotels, restaurants, hostels, army etc; growers and farmers; and marketing personnel - chain stores and groceries shops.

4.6 Marketing Strategy

Local vegetables presenting as considerably preferable on other vegetables (attention to growing condition - water quality, plant protection, advanced technology; picking and harvest condition - post harvest, transportation and keeping high quality of products all year round - size, sturdy, colour and packing); using the healthy image of fresh vegetables nutritious value, healthy, fresh, natural; development of new and special varieties to enlarge the potential customers and to increase the consumption and controlling the competitors in selling points by product differentiation (high quality product, attractive packing, logo and physical separation of the product)

4.7 Advertisement Plan

Advertisement is especially important for a new business. The advertisement plan could be in five stages: Advertisement Concept - market segments, advert style and emphasis; The Slogan - the advantage of the product; The Way - pamphlets, newspaper, professional magazines, media; The Budget and the Timetable -sale seasons or continuously and Advertisement Execution - advert office, publisher, media.

4.8 Trends in International Marketing

Food retail marketing is dominated by two major developments: Globalization and Concentration. In Germany 20 purchasing managers has the power over 90% of all food distribution (Elazar, 2004). Third world economies must be organized on governmental or cooperative level in order to be able to penetrate into distribution systems of the rich nations.

5. CONCLUSIONS FOR DEVELOPING COUNTRIES

- There is need to develop specific indices of maturity for each commodity in terms of stated parameters
- Enact a Perishable Agricultural Commodities Act to promote fair trading in the fruit and vegetable industry
- Act united towards the global markets
- Develop quality standards for all agricultural produce
- Operate your own, independent transport logistics
- Bring your products into European and USA ports and sell from there
- Keep watch on the worlds markets by linking yourself to the information sources worldwide especially information from .gov, .org, .ac and .edu internet addresses
- Develop few, but commercially attractive new produce and market them in cooperation with the established fruit trade.

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