

Innovations in Fruit Technology



by H. Louis Cooperhouse

Innovations in fruit technology, especially in fresh-cut processing, are helping to propel tremendous growth in this segment of the produce industry during this decade. Value-added cut fruits effectively respond to consumer desires for convenience, variety, quality and healthful dietary alternatives. Food Spectrum, LLC, a consulting and research firm, estimates that in 2001, U.S. retail sales of value-added, fresh-cut fruit products totaled \$690 million.

The pioneer of the fresh-cut industry, and an outstanding example of the dramatic growth that can be achieved, is the pre-cut lettuce market. As this segment is beginning to mature, pre-cut lettuce has paved the way for success that can now be attained with fresh-cut fruits and vegetables.

Prior to 1990, one would have thought it inconceivable that consumers would purchase bagged and branded lettuce. However, current sales of bagged lettuce products dominate the value-added

produce category with estimated U.S. sales in 2001 of \$1.6 billion. Cut lettuce products will continue to account for a significant portion of category sales volume for the near term, but its success has opened the door for new opportunities in other packaged fruit and vegetable products. The convenience of product use and the variety offered by prepackaged items have changed consumer purchasing behavior and created "halo" effects for other prepackaged products, such as pre-cut fruits.

Fresh-cut Fruits

In the fresh-cut segment, varieties marketed to date have been dominated by pineapple, melon (including watermelon, cantaloupe, and honeydew), citrus products (including grapefruit and oranges) and grapes. Frequently packaged in polyethylene (PET) containers, these fruits typically achieve shelf lives of two to four days. Because of this short shelf life, Food Spectrum estimates

that two-thirds of retail sales to date originate from products that are cut by hand and packaged at store-level, or within localized facilities that service supermarkets.

In the past few years, and in the years ahead, this category is projected to evolve considerably because of advances in technology. New fresh-cut fruit offerings are now available such as pre-cut melons in party trays with a 10-14 day shelf life. Pre-sliced apples, however, offer an interesting case study in technology. These are currently being marketed with a three to four week shelf life, during which time a blend of additives (such as calcium chloride and ascorbate) provides for an extension of shelf life by inhibiting respiration and the oxidation process, and in which packaging is in a simple two to four mil polyethylene (PE) bag. Sliced apples are also being marketed with up to a seven-week shelf life, and sold together with caramel sauce in two-compartment thermoformed trays, by firms that use similar rinse solutions, but also utilize modified atmosphere packaging. Researchers have also demonstrated that 10 weeks of shelf life is possible for apple slices in syrup; using anti-browning agents together with ultra high pressure processing will be discussed.

Impacting Flavor

Numerous interactions impact the flavor characteristics, sensory acceptability, and therefore the attainable shelf life of fresh-cut produce such as variety, source, season, initial maturity, optimum processing maturity, slicing and cutting equipment, chemical or other treatments and dips, packaging environment, temperature management, shipping and handling. Research has shown that in order to achieve optimum quality and flavor, fruit must be harvested at just the right stage of ripeness. Fruits destined for processing should generally be harvested specifically for that use, and this may not necessarily be the harvest maturity

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Historically, use of a chlorine solution at up to 200 ppm has been effective for a 90-99 percent reduction in total bacteria counts. However, alternative rinse agents are now available, such as the use of peroxyacetic acid and ozone for fresh-cut fruit processing. Ozone in

particular appears to offer significant promise for reducing or eliminating potential pathogenic organisms. In addition, unlike other chemical disinfectants such as chlorine, disinfecting with ozone can be achieved with relatively low concentrations and short contact

The growth of the fresh-cut produce industry was the catalyst that helped the packaging industry evolve.

Historically, use of antimicrobial agents, like asorbates and benzoates, also have been utilized in fresh-cut fruits, such as fruit cocktails, fruit beverages, fruit desserts, pie fillings, etc. These preservatives have long been proven to be effective against yeasts, molds, and certain bacteria. In many food products, sorbate and benzoate are used together to provide greater protection against a wider variety of microorganisms. However, this is most effective if the pH of the product is below 4.5.

New technology innovations for

guacamole and salsa. Premium refrigerated orange, apple, and other juices are now utilizing this process, as an alternative to thermal HTST flash pasteurization processes.

Application of this technology enables minimal processing to products that meet or exceed government safety standards, while providing expected "fresh" flavors but with significantly increased shelf life. Value-added produce, especially cut-fruit products, may retain excellent quality characteristics and achieve extended shelf lives if processed using UHP technology. However, this technology may have product limitations as it can affect changes in structurally-fragile foods, like strawberries and lettuce, and result in cell deformation and cell membrane damage resulting in softening and/or browning. Also, the incorporation of anti-browning agents such as ascorbate, in conjunction with high-pressure treatments in apple slices in syrup, for

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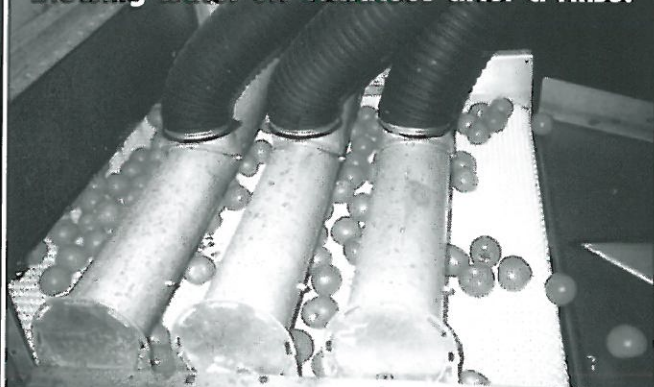
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example, has shown to result in a shelf life of up to 10 weeks.

Irradiation has been an extremely controversial method of food preservation over the years. In fact, fruits were the first item sold using this technology. Pint containers of the nation's first irradiated food, fresh strawberries, were first sold in North Miami Beach on Jan. 25, 1992. The irradiated strawberries had a 21-day shelf life compared with seven days for non-irradiated strawberries. In March 1992, Carrot Top, a grocer in Northbrook, Ill., made national headlines too as it expanded the breadth of irradiated products to its customers. Carrot Top offered mushrooms with a three-week shelf life without browning; vine-ripened tomatoes with a three-week shelf life that didn't get moldy and didn't need ethylene treatment; and onions that didn't sprout for more than three months.

This era witnessed the launch of a very aggressive campaign by a few vocal groups that fought against the introduction of this technology. Vocal opposition has now dramatically declined, and almost a decade has passed since the first irradiated foods were introduced. Consumers are beginning to find irradiation to be an acceptable technology to combat their real concerns about contracting food borne disease.

Packaging Options

The packaging stage of manufacturing offers a number of highly-differentiated options for the food processor as well. Packaging hurdles include modified atmosphere packaging (MAP), clean room packaging, and utilization of appropriate packaging materials and packaging systems. Modified atmosphere packaging, via reduced-oxygen, may be a technology chosen to help a fresh-cut processor achieve a much longer shelf life. However, because MAP results in a dramatic change in the *time* it takes for product to spoil, and the *type* of bacteria that will cause this spoilage, it creates significant additional risk as. Also, incorporation of other barriers and microbiological challenge studies will minimize such risks.

The growth of the fresh-cut produce industry was the catalyst that helped the packaging industry evolve, and the refrigerated foods category evolve as a whole. Films, for example, may contain enhanced barriers to oxygen, moisture, and/or light, and some may have anti-fog capabilities to reduce condensation. Laminated materials are widely used in the industry today, that are manufactured by bonding two or more layers together with adhesives in which each layer performs a particular role. Microperforation is a technology that can be used with high-respiring fresh-cut produce, and offer high moisture vapor transmission rates for products like cauliflower.

Many technology alternatives are now available. Application of these technologies will enable the marketability of a wide array of new product offerings for consumers in the years ahead. Improvements in product shelf life and safety, and the integration of improved refrigeration units in supermarket produce sections will enable the birth of new product categories and new markets. ■

Editor's Note: Lou Cooperhouse is president and CEO of Food Spectrum, LLC, a consulting and research company specializing in value-added foods. The company's recent report, **Retail Prepared Refrigerated Foods: The Market and Technologies**, analyzes products sold in supermarket produce, deli and meat departments. It offers market size estimates, forecasts, and market shares held by major competitors, as well as competitive profiles and a comprehensive analysis of trends affecting the market. The report also discusses in detail current and emerging process and packaging technologies driving new and established products. Further information is available at www.foodspectrum.com. Lou Cooperhouse can be contacted at lcooperhouse@foodspectrum.com.