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One distributor's experience with irradiated produce

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Purpose of the review: This review focuses on irradiation and highlights different aspects of Melissa's® experience with the distribution of irradiated produce.
Findings: Mexican irradiated mangos (*Mangifera indica*) and Vietnamese irradiated dragon fruit (*Hylocereus undata*) are the hallmarks of Melissa's® irradiated program comprising the largest drivers of volume, with sales of total irradiated produce increasing from approximately 900 Stock Keeping Units in 2010 to 44,300 in 2014. Stock Keeping Units are reported in order to preserve Melissa's® proprietary interest in the volume of specific pack sizes. Melissa's® distributes other irradiated produce including papaya, rambutan, longan, sweet potatoes and mangosteen.
Directions for future research: Ongoing food irradiation research offers potential for increased use on other imported commodities, especially for phytosanitary disinfestation treatment on fresh tropical fruits. Melissa's® endeavors to replicate the success of the Mexican irradiated mango program in the development of the recently USDA approved Australian irradiated mango program. Australian mangos are picked fresh, de-sapped, packed, gassed with ethylene, irradiated and then delivered to the USA West Coast by air container in a little over a day. Finally, Thai irradiated mangos, especially *cv Nam Doc Mai,* would encounter sizeable demand in consumer markets in the USA if methods could be found to overcome the limitation of the tender skin in successfully irradiating the mango.

Keywords: irradiation; phytosanitary disinfestation

Introduction

Melissa's® World Variety Produce, Inc. (Los Angeles, California, USA) is currently the largest distributor of specialty produce in the USA, with a warehouse capacity of 280,000 square feet. Melissa's® has been interested in irradiated food for almost 15 years and caters to retail customers that appreciate and celebrate edible biodiversity and the nuances of flavor between specialty varieties. Our company was intrigued by the potential of irradiated produce long before being approached by major retailers at the Produce Marketing Association's (PMA's) Fresh Summit in 2000.

Melissa's® participation in seminars and various visits to food irradiators around the USA (eg, Illinois, Florida, California, and Hawaii) had educated Melissa's® on the technical aspects, procedural safeguards, and the benefits of food irradiation. A literature review revealed scientific validation of food irradiation and showed that these processed had been well documented by the WHO, FAO, CDC, AMA, and others. Melissa's® was aware of food irradiation efficacy in pest disinfestation, practicality in food safety, and shelf life extension at the upper ranges of dosages permitted by the FDA.

Although Melissa's® distributes other irradiated produce, including papaya, rambutan, longan, sweet potatoes and mangosteen, Mexican irradiated mangos (*Mangifera indica*) and Vietnamese irradiated dragon fruit (*Hylocereus undata*) are the hallmarks of Melissa's® irradiated program and the largest drivers of volume (Fig. 1). In 2014 total Stock Keeping Units (SKUs; used instead of volumes by weight for proprietary reasons) for mangos and dragon fruit were over 25,000 and 10,000, respectively. Total irradiated SKUs in fresh produce have risen exponentially from a little over 900 in 2010 to 44,300 in 2014 (Fig. 2), indicating a significant increase in consumer demand and acceptability of irradiated produce.

Hawaiian papaya and tropical fruit

Melissa's® first direct experience began in 2000 with the Hawaii Pride LLC irradiation facility in Keaau, HI. Melissa's® attended the inauguration of the plant, which utilizes a Sure Beam e-beam/x-ray irradiator principally to irradiate papaya (*Carica papaya*), rambutan (*Nephelium lappaceum)* and longan (*Dimocarpus longan*) for export to the USA mainland. In the initial years of the program (2001-2004), purchased volumes of papaya were quite large. However, by 2005 the increasing low cost non-irradiated competition and supply consistency from Brazil (strawberry papayas) and Central America and the Caribbean (Tainung papayas) resulted in a drastic drop of discretional market purchases of irradiated Hawaiian papaya. Today, the papaya program from Hawaii essentially functions as a stop-gap program to service irregular supplies from other competitors.

Purchases of rambutan and longan have remained low to date and so Hawaii is not relied upon as a major source. Non-irradiated rambutan is available from Florida and Central America and irradiated rambutan is available from Vietnam at very competitive prices. Furthermore, longan faces a low and very elastic demand, as most USA retailers and consumers are unfamiliar with the fruit. Rambutan, with its cosmetics, faces slightly more promising market prospects, but as a non-

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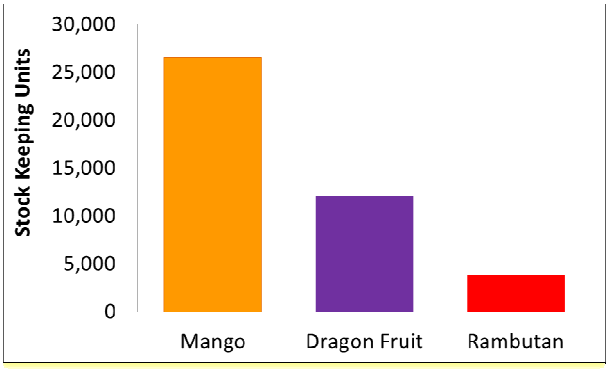
Figure 1: Relative volume of irradiated tropical fruit imported into the USA for distribution by Mellissa's in 2014.



climacteric fruit, it has to be picked ripe making it vulnerable to spinturn darkening and product desiccation [1].

Hawaiian Okinawa sweet potatoes (*Ipomoea batatas)* have demonstrated steady annual growth but at a low base rate, a little over one-tenth the sales volume of dragon fruit, one of the largest irradiated imports. Okinawa sweet potatoes are a relatively obscure vegetable, and the sweet potatoes face a low elasticity of demand. Sweet potato volumes remain well below that of most major irradiated tropical fruits, but SKU's have arisen from a little over 900 in 2010 to nearly 2900 in 2014.

Thai tropical fruit

Thailand, with over 11,000 vascular plant species spread out between 20-26 degrees North latitude, is one of the world's most bio-diverse countries with a wide assortment of edible tropical fruit [2, 3]. This tropical base confers great commercial potential. In the early 2000's, mangosteen (*Garcinia mangostana*), rambutan, lychee (*Litchi chinensis*), and longan groves were visited by Melissa's® and inspected for food safety, sanitation, and USA regulatory compliance. Shortly before certification of the USDA facility, Isotron (now Synergy Health Thailand) was visited to ascertain cold chain custody, efficacy of treatment, food safety, and flow of product.

Thailand is the leading mangosteen producing country in the world. Mangosteen represents considerable potential principally because of its unique organoleptic qualities and its delightful character as the 'Queen of Tropical Fruits'. However, erratic supplies, diversions to China, port closures, and catastrophic rains have meant the program has never been able to demonstrate steady growth. In addition, competing non-irradiated supplies from Puerto Rico and recently, Mexico, have cut into the market for Thai fruit. Thai mangosteen typically sells at a price 25-50% higher than non-irradiated mangosteen. Two factors are associated with higher cost: airfreight and irradiation. While per unit costs of irradiation are relatively nominal, transportation costs to and from the irradiation facility, as well as costs associated with minimum volume requirements for the facility to treat the fruit all add up.

Mangosteen has a notoriously short shelf life and customers tend to use the greenness of the calyx as a gauge of freshness, flavor and quality. Another non-climacteric fruit, mangosteen must be picked ripe (but before onset of gamboges), air-freighted, and then quickly moved into distribution channels. The physiology and high respiration of mangosteen limit logistics alternatives (eg, ocean transit) and consequently unit prices are high, which, with a novel fruit facing an elastic demand curve, restricts sales and broad market penetration.

Mangos represent another potential opportunity out of Thailand. Nam Doc Mai ("Nectar of the Flowers") and Mahachanok are varieties that originated in Thailand and possess superior eating qualities. However, the thinness of their skins has prevented successful irradiation treatment and distribution. This is unfortunate. Mangos (especially good tasting, virtually fiberless mangos) are a gateway commodity into the tropical fruit category [4] – they lead the way for other tropical fruits like papayas, coconuts, and even pineapples. Thai mangos would encounter sizeable USA demand if methods could be found to overcome the limitations of the skin in the irradiation process.

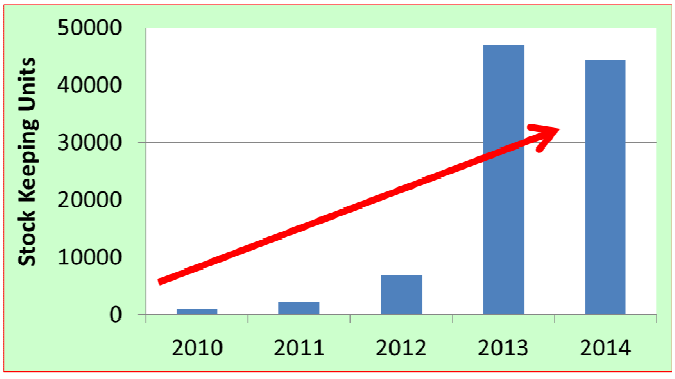
Mexican mango

The real benchmark commodities for Melissa's® World Variety Produce irradiation program have been Mexican tree-ripened mangos *(Mangifera indica*) and Vietnamese white dragon fruit (*Hylocereus undatus).*

As happens so often, new commodities and new techniques need a retail champion: a visionary who can see potential, grasp opportunities, and boldly lead, undeterred by minor pitfalls. In the case of the Mexican tree-ripened mango program that champion was a major Northeast upscale food retailer. Their positive sales experience with irradiated ground beef convinced them of: 1) the efficacy of food irradiation in the promotion of food safety; 2) the potential application (albeit at lesser irradiation doses) for obtaining riper and fresher produce; and (3), and very importantly in this case, the retailer wanted to drive sales in the tropical category with a distinct point of differentiation: a good tasting mango.

Conventional USDA phytosanitary treatment for mangos requires mangos to be picked green (before ripeness) in order to

Figure 2: Trend in volume of irradiated fresh produce imported for distribution by Melissa's®.



withstand the requisite hot water or steam vapor treatment. Yet, both treatments are deleterious to mango flavor and shelf life. Instead, irradiation allows for a later-harvested mango with better phenolics, volatile aromatics, and improved postharvest maintenance. Benebión irradiation facility (Guadalajara, Mexico) had the scale, capacity, logistics, and readiness to commit to the program. In just two years, the irradiated Mexican mango is the number one commodity in Melissa's® irradiated portfolio—its volume is nearly ten times that of Okinawa sweet potatoes and more than double that of the next leading irradiated commodity, dragon fruit from Vietnam. And this growth is not in any way encumbered by irradiation signage (radura symbol and advisory language) posted at retail in compliance with the FDA requirements.

Based on the success of the Mexican irradiated mango program, Melissa's® envisions a bright future for the entry of Australian irradiated mangos, which are picked fresh and ripe, treated, and then delivered to the USA West Coast in a little over a day. This promising contra-seasonal production confers opportunity to introduce flavorful and virtually fiberless mango varieties into the USA during the very desirable Thanksgiving to Easter window when they will be able to compete very favorably against limited and inferior varieties.

Vietnamese dragon fruit

Dragon fruit from Vietnam has been a success story. Initial import problems were related to delivery quality with the product arriving old, shriveled, desiccated and moldy at entry. These physiological problems stemmed primarily from improper picking times and poor temperature control during sea transit, and were unrelated to the prescribed irradiation treatment of 150 Gy. Eventually these horticultural and logistical problems were resolved, and the Vietnamese dragon fruit import program has skyrocketed from less than 100 cases in 2010 to more than 12,000 cases in 2014.

In summary, Melissa's® is supportive of the USDA food irradiation program. Melissa's® views this program as a benchmark for phytosanitary standards that accomplishes the dual goals of optimal biosecurity and greater access to tropical fruits and vegetables. USA demographics are rapidly changing: the consumer base is becoming more diverse, tastes are becoming more sophisticated, and more and more exotic produce is being demanded. The USDA phytosanitary irradiation programs have safeguarded agriculture in the USA, while accommodating wider and more diversified access to safe, healthy, nutritious food.

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Papers of interest have been highlighted as:
* Marginal importance
** Essential reading

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