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GRAPE PROCESSING AND UTILIZATION IN FLORIDA[1]

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Abstract. **To maintain growth, the grape industry must balance production with marketing. From 1977 to 1981, the industry grew from 400 to 1000 acres and 2000 acres is estimated by 1986. From the third year after planting there is usually more than 160% increase in production each year until about the fifth year, when this begins to level off. Although "muscadines have been sold through retail supermarkets" and the "you pick" market, these have limitations and production is currently ahead of marketing capacities.**

Processed products provide the logical area for expansion. Possibilities include: wine, juices, beverage, jams, jellies, raisins, canned grapes, and by-products. Wine making has been promoted through improved varieties, a strong grower commitment and increased understanding of grape chemistry through research. Juice quality has improved with better processing procedures. Many products depend on refinement of a deseeder and/or development of seedless varieties. Grape pomace has animal feed and by-product value.

Grape Processing and Utilization in Florida

Although the combined volume of processed grape products in the U.S. exceeds the fresh market quantity by about a ratio of 3 to 1, the amount contributed by Florida grapes to both categories is negligible. However, it is clear from the above example that a healthy grape processing industry is an integral part of successful commercial viticulture.

At present Florida ranks about 19th in grape production and acreage is expanding steadily. The two factors which have limited grape processing in state—suitable varieties and adequate quantity still operate, but progress is being made (3). The major categories of processed products are: wine, juice, conserves, raisins and by products. This report will discuss problems and progress with these items and emphasize the technical needs and research strategy required for the development of a viable grape processing industry in Florida.

Processing Overview

The wine picture was brightened considerably due to increased knowledge of enology practices suitable for either bunch or muscadine types and the development of improved varieties. Table 1 shows the processing grape situation as of 1981. By far most wine efforts are with muscadine grapes due to their regional popularity and their potential ease of harvesting. Light shaking of the vine results in release of most ripe berries. If the variety has a dry stem scar and ripens fairly evenly, harvesting costs can be substantially reduced compared to bunch grapes (1), although with hand harvesting, bunch grapes are collected somewhat more efficiently.

In addition, maturity grading by density separation in a series of brines of varying specific gravity may provide a simple way of eliminating extremes in maturity, thus improving the quality of raw material for processing (9). At present the fruit volumes involved preclude standard machine harvesters, except for hand-held shakers for muscadines (1).

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Table 1. An inventory of grape varieties and breeding lines for processing use in Florida.

Variety/Breeding Line		Season[z]	Brix[y]	pH[y]	Titratable Acidity[y]	Uses	Remarks
Bunch (Green)							
Stover		7/9	15-18°	3.3-3.7	0.5-0.9	Wine, Juice	Good Quality, Consistent
Lake Emerald		7/30	16-19	3.4-3.6	0.7-1.3	Wine, Juice	High Sugars & Acid, Tendency to Brown
L9-10		7/18	14-16	3.4-3.6	0.9-1.1	Wine, Juice	High Yield, Good Quality
H18-37		7/6	16-19	3.4-3.6	0.9-1.1	Wine	Unique Flavor, Earliest Maturity, However, Susceptible to Blackrot and Anthranose
H15-13		7/8	16-17	3.4-3.6	0.6-0.8	Wine	Unique Flavor, High Yield
Bunch (Purple)							All Purple Bunch Grapes have some Concord Character But Pigment Stability Questionable for Wine.
A1-32		7/16	14.5-16.5	3.4-3.6	0.9-1.5	Juice	
H17-22		7/13	13.5-17.0	3.5-3.6	0.9-1.2	Juice	Pleasant Flavor, Earliest Purple Cultivar
E12-59		7/21	14.5-16.0	3.5-3.7	0.9-1.7	Wine, Juice	Female Cultivar, Requires Pollinator
E11-40		7/22				Juice, Wine	Multipurpose 'Concord' Type
E4-33		7/15	13.0-15.0	3.4-3.5	0.9-1.3	Juice	Multipurpose 'Concord' Type, Occasional Pierce's Disease Symptoms
Muscadine (Bronze)							
Dixie		8/23	16-20	3.4-3.6	0.3-0.5	Wine, Juice	Good Quality, Consistent, Wet Stem Scar
Carlos		8/27	14-17	3.3-3.5	0.3-0.5	Wine, Juice	Dry Stem Scar, Susceptible to Pierce's Disease
Welder		8/21	15-19	3.4-3.6	0.3-0.5	Wine, Juice	Good Quality, Consistent, Wet Stem Scar
Doreen		9/8	15-18	3.4-3.6	0.3-0.5	Wine	More Experience Needed
Scuppernong		9/16	14-16	3.4-3.7	0.3-0.5	Wine	Of Historical Interest, Dry Stem Scar
GA 18-7-3	Georgia Breeding	Did Not Fruit At	14-21	3.2-3.5	0.3-0.5	Wine	Interesting Non-Muscadine (Vinifera) Character
GA 23-45	Lines	Leesburg Yet	14-19	3.4-3.7	0.4-0.6	Wine	More Experience Needed
Fry		8/25	16-19			Raisins & De-seeded Products	Large Berry Conducive to Deseeding, Wet Stem Scar
Higgins		8/31	16-19			Raisins & De-seeded Products	Large Berry Conducive to Deseeding, Wet Stem Scar
Summit		8/28	17-20			Raisins & De-seeded Products	Large Berry Conducive to Deseeding, Dry Stem Scar
Muscadine (Black)							
Noble		8/29	14-20	3.3-3.6	0.6-1.1	Wine, Juice	Good Quality, Consistent, Pigment Stable, Wet Stem Scar
NC 80-74		8/22	14-16	3.2-3.4	0.4-1.2	Wine, Juice	Similar to Noble, Dry Stem Scar
Regale		8/22	14-16	3.2-3.5	0.5-1.4	Wine, Juice	Similar to Noble, Wet Stem Scar
Tarheel		8/21	14-17	3.2-3.4	0.7-1.0	Wine	Intense, Stable Color, Medium Stem Scar
Southland		8/28	15-18	3.2-3.5	0.8-1.2	Juice, Wine	Pleasant Flavor, Marginal Color Stability. Dry Stem Scar
Creek		9/19	12-16	3.0-3.3	0.9-1.3	Juice, Wine	Very Late Maturity, Poor Color Stability, Dry Stem Scar
Jumbo		9/1	15-17			Raisins & De-seeded Products	Large Berry Conducive to Deseeding, Wet Stem Scar

[z]Average date of maturity at Leesburg Arc. can vary ± 1 week.
[y]Highly maturity and extraction regime dependent.

At least 75% of wine making activity in Florida (both amateur and commercial) is based on muscadines. However, we feel that the wine making potential of bunch grapes is not being adequately exploited. The first Euvitis ripen about 6 weeks before the first muscadines (late June in Central Florida, Table 1). The higher acidity, fruity character of bunch grapes make for distinctive wines in their own right as well as complemental blending stock with muscadines. However, acceptable wine from red bunch grape breeding lines is still an elusive goal. The initial bright red color browns and/or pigments precipitate despite careful handling. In addition, the wines possess a distinct 'Concord' character which is not associated with quality wines.

Grape juice processing, lacking the "romance" of wine has progressed less rapidly. Nevertheless, the proximity of vineyards to the Citrus Industry and the potentially complementary (non-overlapping) harvest seasons suggest some interesting commercial possibilities. In the first approximation, Florida grapes with the best wine potential also make good juice. The major exception are some of the purple bunch grape breeding lines with poor wine quality but excellent 'Concord'-type juice characteristics (Table 1). Ironically, this lack of 'Concord' flavor has been cited as a major limitation to muscadine juice popularization. 'Stover' juice is quite similar to apple juice in appearance and flavor, and other green bunch grapes produce pleasant, fruity juices.

The muscadine juices are overly sweet due to inadequate acid extraction from the skins in the cold press regime—necessary to minimize browning in bronze muscadine juice. Black muscadine hot press juice has a low to ideal Brix/Acid ratio of about 15 to 25, but upon detartration the ratio rises to over 35 as in cold press juice. In general, ratios of about 25-30 are preferred for grape juices and this can be achieved either by adding citric acid or low ratio citrus juices (2). Very little is known about volatile essence com-

position and recovery from Florida grapes, and such information will be required for frozen concentrate grape juice to become feasible.

A considerable proportion of U-pick grapes is home processed into popular grape jelly and modest amounts of muscadine jelly are available commercially in the southeast, some as high priced specialty items. In the early 1970's an exceptionally high quality muscadine jelly was developed at Auburn University based on freeze-concentrated juice (to minimize heat treatment). The development of jams, pie fillings, canned grapes and other products utilizing discrete grape pieces will be predicated upon a successful deseeding device or a seedless grape.

Technical Needs

The most important step in grape processing and utilization in Florida has been simply to recognize the critical short and long term needs of the grape industry (3). Factors which serve to inhibit development efforts are: the availability of processing varieties (including seedless types); unreliable volume of grapes; lack of quality standards; inefficient economies of scale; unsufficient understanding of grape chemistry; undeveloped markets.

Varieties—While the availability of quality seedless cultivars will have great fresh market impact, seedlessness also has important processing implications for whole grape products and specialties such as raisins, canned grapes, preserves, etc. The lead time to develop, test and release new varieties is about a decade. With special multiple requirements (i.e., unique flavor combined with dry stem scar, uniform ripening and pigment stability), this time is even longer, involving exhaustive multiple site testing of numerous breeding lines. At this time the desirable processing characteristics are just beginning to be recognized and present varieties are only first positive steps in that direction (10).

Deseeding and seedless products—Recognizing that all muscadine grapes currently in commercial production and all those muscadines forecast for commercial use in the reasonable future, contain seeds which inhibit the development of processed muscadine products, the U.S.D.A. Citrus and Subtropical Products Laboratory, Winter Haven, Florida, has embarked upon the design and development of an inexpensive deseeder for muscadine grapes (4).

This prototype was designed, built and tested last year. Its material and labor cost was $400. Autoloading and core ejection problems have to be overcome in this prototype. The Winter Haven lab has made several design improvements including core ejectors and an autoloading ramp to be built into their "in-line" deseeder currently under construction. If the model functions as designed, it will process 600-1000 muscadines/minute. Given the economic parameters of scale for vineyards in the southeast, the successful development of a deseeder of this scale and cost should be a significant step in muscadine processing.

Also recognizing the frantic nature of vineyard harvest times and the current priority of fresh fruit market over a processed products market, that same laboratory has done *some* preliminary storage studies on canned muscadines in several stabilizing solutions at several temperatures (5). In these experiments deseeded Dixie muscadines were stored for a period of a year and maintained reasonable color, flavor and texture. By storing excess grapes or "seconds" until after the rush of the harvest and fresh market activity subsides, the production of processed muscadine products can be far more useful and effective and chances of success will be greatly improved. Continued advances in storage technology for muscadine growers will open new markets while lengthening the production season and decreasing losses of excess fresh fruit and/or high quality seconds.

As part of their continuing efforts on behalf of muscadine grape processing, the Winter Haven *lab recently tested* several commercial enzymes on Higgins muscadines to determine whether the mucilagenous skin and pulp could be softened during the deseeding, canning and storage processes to result in a more readily acceptable and useable product. Results of these experiments should be available in December '81 or January '82.

Integrated Operations

Grape production costs in Florida are higher than in most parts of the U.S. due to essential cultivation and crop protection inputs. Therefore, for processing enterprises to be viable, operation must be highly efficient. This is easier to accomplish on a large scale and over an extended season (hence the practicality of integrating bunch and muscadine processing).

Wine manufacture illustrates this point. The yield of wine must varies with grape variety and wine type. While it is possible to achieve juice yields of up to 80% (about 190 gallons/ton) by hot press or extended fermentation on the hulls, lighter pressing may be called for with some colored grape must extraction procedures. White wine, derived from green or bronze grapes cannot tolerate pressing extremes, and free run or light press treatments yield 40 to 60% (95 to 150 gal/ton). Thus, substantial grape soluble solids are left in the pomace. A large, integrated operator can extract this material by additional pressing and utilize it as blending/fortification stock or brandy. No such alternative exists for the small winery making only several table wine types. The pomace may also have animal feed value, but for optimum utilization would require drying, milling, formulation, blending and stockpiling—all capital intensive operations requiring a reasonably continuous supply of pomace.

In preliminary trials grape pomace from freshly pressed bronze muscadines was readily accepted by cattle. Mature beef cows consumed up to 50% of their dry matter intake in the form of grape pomace without any indication of digestive disturbances. The material sours after about 24 hours so it should be fed within a day of pressing. Pomace feeding has the potential of reducing feed costs and turning a waste material into animal protein and the indigestible fraction ultimately to fertilizer—refined and distributed by the animal.

In addition, there are a number of potentially valuable byproducts in grape pomace and wine lees—yeast, tartarates, seed oil and protein, pigments, tannins and minor components. If available in reliable and sufficient quantities over an extended period, these components might form the basis of recovery operations which both produce items of commercial value and reduce waste disposal requirements. In this regard, the Florida citrus industry is an excellent example of successful byproduct recovery and utilization based upon technical and economic integration of many diverse but complimentary processes (8).

Quality Control and Standards

An important prerequisite for industry development is the establishing and enforcement of quality standards from vine to final product. These must be based upon the mutual needs of both grower and processor. Some of the more obvious criteria are described in Table 2. The influence of variety, season, location, maturity and processing upon grape products must be well understood. Statistically sound,

Table 2. Grape quality factors influencing processed products.

A.	Variety
	1. Durability of vine and grape (pre- and postharvest)
	2. Yield of fruit and juice
	3. Characteristics—typical, distinctive flavor, color and texture with seasonal and locational uniformity
B.	Maturity
	1. Ripening eveness and size uniformity
	2. Ease of machine harvest (dry stem scar)
C.	Defects—absence of decay, extraneous matter, extremes of maturity and agricultural chemicals
D.	Morphology
	1. Skin and pulp—easily crushed and pressed
	2. Seeds—few and centrally located
	3. Size and shape—large and spherical (for deseeding)
E.	Composition
	1. >14 Brix <20
	2. >3.0 pH <3.7
	3. >0.5 Acid <1.0% (as tartaric), <trace of acetic acid
	4. >25 Brix/Acid ratio <35
	5. High pigment intensity and stability (reds)
	6. Minimum tendency to brown (whites)
	7. Tannins—low in amount and/or astringency

practical sampling and analytical techniques need to be developed, tested and the data relied upon in commercial transactions.

Energy—Florida agriculture has more than average energy constraints (11). Viticulture and grape processing are energy intensive procedures. High ambient temperatures during the summer harvest season call for prompt, efficient refrigeration in handling, juice/must extraction, fermentation, cold stabilization, aging and storage. There are few steps in either juice or wine manufacture where the product can tolerate temperatures above 80°F, and the extensive use of air conditioning or refrigeration is mandatory for high quality products. In addition, unit operations such as crushing, pressing, pumping, centrifugation, filtration and bottling will generally be performed on a batch basis and require more energy per unit than large scale continuous operations. There are newer methods of grape processing which consist of in-field crushing and bulk holding of the crush or expressed juice (7). In the interest of process efficiency, technical progress with these methods should be followed. At some time they may be relevant in Florida.

Progress with subproducts and byproducts entails a thorough knowledge of the chemistry and physical/mechanical properties of grapes, the influence of processing upon components and product development. The small, intermittent scale of processing may initially negate the economic feasibility of byproducts. However, the incentive for obtaining the greatest return from the crop in all forms is evident.

Florida Grape Promotion

Over the last 43 years the orange crop in Florida went from 3 to 96% processed (6). This growth was accomplished by processing research promoted by the economic viability of processed products, aggressive marketing and the recognition by both grower and processor of the need for quality and consistency. Grower cooperatives evolved to meet the demand for a reliable fruit supply. The Florida Grape Marketing Association promises to provide this important marketing function for both fresh and processing grapes.

One very successful marketing tool is the U-pick operation. Customers visiting the vineyard observe the various cultivars on the vine and, by sampling and picking the fruit gain a personal interest and involvement. While many customers are familiar with Florida grapes, newer residents and visitors rapidly gain an appreciation of and a taste for local grapes. Although the tough skins and seeded nature of muscadines and the seediness of bunch grapes are barriers to those accustomed to the bland seedless varieties, the unique flavor of Florida grapes makes many friends.

Fresh grape juice is a rare and unique product. If freshly prepared and served in a U-pick vineyard, this product should be a valuable merchandising aid. The juice could come from the smaller or less popular grapes and even be picked, crushed and pressed by the customer.

Current Activities

Research in progress consists of: 1. evaluation of varieties and breeding lines under consideration in Florida or available through cooperators in other Southern states; 2. development of improved and practical wine making, juice manufacture, and deseeding techniques which optimize the desireable characteristics of available grape types while minimizing undesirable features; 3. study of grape chemistry and the influence of processing upon key components—acids, sugars, tannins, pigments, and flavor; 4. refinement of quality standards as predictors of optimum maturity and product quality; 5. establish the influence of postharvest and preprocessing storage and handling upon product quality; 6. development of beverage, confection and deseeded grape specialty products; 7. byproduct recovery and stabilization schemes for economic utilization of all processing-generated residues; 8. evaluation of grape pomace feed value and minimum stabilization/field handling requirements to insure consumption by cattle.

Clearly the resources devoted to grapes in Florida from all cooperating organizations—IFAS, Fla. A & M University, USDA, Fla. Department of Agritulture are rather modest considering the magnitude of the task. Fortunately, we can draw upon the talent and experience of the entire food technology community. Lessons learned by the citrus industry in Florida, the grape industry in California and the Northeast, their respective technical institutions and regional cooperators can be applied toward solving Florida problems. However, the primary effort must be generated in state by developing a balanced relationship among cooperating institutions and the grape industry. Processing is only one link in the chain from vineyard to consumer and any weakness in breeding, cultivation, processing or marketing can adversely influence future prospects in state.

One can view with admiration a mature, viable food processing industry based on a local commodity. Such activities contribute to the well being of growers, processors, allied industry, consumers and the state as a whole. It should be recognized that such enterprises do not spring up overnite but are due to foresight, dedication, hard work and perseverance. Moreover, the job is never done: a continual effort to keep abreast of technology and the competition is mandatory for success. Florida has one good model in citrus. Can the grape industry evolve as successfully?

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MUSCADINE GRAPE MARKETING ALTERNATIVES: FRESH VS. PROCESSED VS. DIRECT MARKET

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Abstract. **Marketing considerations are paramount for a profitable business and should permeate and influence production decisions. The appropriate marketing channels best suited for the respective varieties should influence the grape grower's decisions of which varieties to plant. Cultural practices in the vineyard and economic conditions will critically influence the grower's marketing decisions and returns expectations. The major factors affecting these returns and managerial marketing decisions are presented via a decision-tree framework to assist grape growers in either the fresh commercial, processed, or direct marketing of Florida's muscadine grapes.**

> "Marketing is so basic that it cannot be considered a separate function . . . it is the whole of business seen from the point of view of its final product—that is, from the customer's point of view."

This statement by Peter Drucker emphasizes the importance of consumer response and acceptance for the success of a business. Producing and marketing muscadine grapes is a business whose success depends upon customer sales and sound marketing management. A marketing plan which analyzes the mix of marketing decisions is as important as a production plan. A proper marketing plan evaluates decisions on products, pricing, promotion, and place. These considerations will be discussed as they relate to the Florida muscadine grape grower. The focus of this paper is on 1. comparing fresh commercial, processed, and direct market alternatives, 2. managerial marketing decisions and strategies and 3. the major factors affecting grape grower returns.

Marketing Mix

Commercial production of muscadine grapes has increased in the last decade, with most grapes marketed directly to consumers, primarily through pick-your-own (PYO) outlets. As more growers, both hobbyists and commercial producers, discover the profit opportunity and enter the market with more PYO operations, muscadine grape growers will need to analyze marketing alternatives and marketing strategies.

Product Decisions

Marketing decisions must be made along with production decisions when selecting the varieties to plant. Some muscadine varieties are better suited for processing as a wine or juice grape, while others were developed primarily for fresh consumption (3). Consequently, planting a particular variety may dictate the market the grower must pursue for a profitable and successful venture.

Pricing Decisions

"Everything is worth what its purchaser will pay."

This thought sounds reasonably simple, yet it embodies complex considerations. Not only are pricing decisions based on consumer responses, but also on competitive actions (pricing, volume or quantity discounts, services rendered, purchase incentives, other merchandise available, etc.) and internal cost considerations. Rational economic decisions mean that, at a minimum, a grower would price above average variable costs and, for an economic profit, price above average total costs. Enterprise budgets can aid in evaluating production and marketing costs and prices (5). Dividing total costs by the yield indicates the breakeven price; similarly, dividing the total costs by the expected market price reveals the yield necessary to break even.

Promotional Decisions

Promotional decisions are concerned primarily with advertising, publicity, and selling or sales support. Failure to address these decisions adequately has led to losses for some grape growers. In some cases unsuccessful PYO or direct market operators have not advertised their vineyards either in the media (newspapers, radio, etc.) or with eyecatching, easy-to-read roadside signs. Successful direct markets do not just happen, they are planned and nurtured. Selling does not just involve getting the customer to the market (PYO, roadside, farmers') but also the proper display and handling of produce and the proper treatment of the customer. Guidelines for successful and profitable direct markets are available (4,6). A recent study showed word-of-mouth as the principal means by which customers learned of a particular vineyard (2). However, many had simply noticed the vineyard while driving, which emphasizes the need for roadside advertising.

In the fresh market, point-of-sale (POS) materials and/or packaging are important for catching a customer's interest and conveying what the product is, its price, and other factors such as color, variety, Florida-grown, etc. Super-

[1]Florida Agricultural Experiment Stations Journal Series No. 3525.