PROCESSING RESEARCH WITH FLORIDA GROWN GRAPE CULTIVARS

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ABSTRACT

Selected grape cultivars and breeding selections grown at Leesburg during the 1968 and 1969 seasons were processed in 3 forms: single strength canned juice, frozen concentrate, and wines. Muscadine types Magoon, Southland and a mixture of Chief, Hunt, and U.S. 42-12B produced good colored and distinctively flavored single strength hot pack juices and frozen concentrates. The same cultivars produced acceptable red wines and the bunch variety Stover yielded a good white wine. Failure of some grape cultivars to produce acceptable products was usually due to low sugar-acid ratios or poor color. Most cultivars were consistent in character over both seasons except Norris whose quality was markedly improved in 1969.

INTRODUCTION

Despite favorable topography, climate, and growing season, Florida has not developed a grape industry commensurate with the State's potential. Grape cultivation was marginally successful in the 1920's until the Pierce's disease virus infected vineyards (1). Recently, renewed efforts to overcome previous cultivation problems have met with some success and resulted in a number of promising grape cultivar releases (2).

Several of the promising introductions appear suitable for processing. In Georgia some valuable studies involving juice extraction procedures and processed products have been conducted with Muscadine type grapes similar to those grown in Florida (3). Earlier processing studies involving the bunch grape variety Blue Lake, grown in Florida indicate that acceptable single strength juice could be produced (4). However, Blue Lake lacked typical Concord grape flavor, a quality attribute of considerable importance in the grape juice industry (5). Also, development of brown color was noted in stored samples.

While Florida grape breeders are presently investigating breeding selections with Concord flavor characteristics, clones now in cultivation are of sufficiently high quality to merit process investigations. Thus, single strength hot pack juices, frozen concentrates, and wines from promising clones have been prepared and evaluated.

EXPERIMENTAL METHODS

Mature grapes were harvested from experimental plantings at Leesburg during July and August 1968 and 1969 (Table 1), packed in 20 lb capacity lug boxes and transported within 24 hours to Gainesville where they were held at 35°F for 1 to 3 days before processing.

Grapes were weighed, inspected to remove refuse and damaged berries, washed, drained and destemmed by hand. With some varieties, destemming was easily accomplished by shaking the bunch. With others, tedious hand picking was needed. Muscadines were practically free of stems as received. Berries were passed through a paddle pulper, fitted with a 0.125" screen, which effectively crushed the fruit and separated seeds and skin from the pulp and juice. It was necessary to pass the muscadines pulp and skins through the pulper twice in order to improve yield and color extraction. A final pass through the pulper fitted with a 0.020" screen yielded a thick homogeneous juice with the typical color and flavor of the particular grape variety. Potassium metabisulfite ($K_2S_2O_5$) was added to all bunch grape juice destined for fermentation to prevent enzymic browning and to reduce the natural microflora. In 1968 2 g $K_2S_2O_5$ was added to 10 Kg of pulp, while in 1969 it was added during crushing at the rate of 2 g 10 Kg of grapes, No $K_2S_2O_5$ was added to the muscadines during crushing in view of the undesirable fad-

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ing of the red color which occurred in the presence of SO_2.

The resulting juice was analyzed for soluble solids (Brix) by an Abbe refractometer. The pH was determined on 10 ml juice diluted with 90 ml distilled water, and titratable acidity (as g tartaric acid/100 ml) obtained by titrating the same solution to pH 8.1 with 0.1*N* NaOH.

Wine Preparation

Based upon the sample Brix and percent acid, the juice was ameliorated by adding sucrose to raise the Brix to 21° and water to reduce the acidity to less than 0.9%. In all cases amelioration was limited to 25% added sugar plus water on an as-ameliorated basis.

When $K_2S_2O_5$ was added, no additional pretreatment was necessary. Muscadine musts were pasteurized by passing thru a Votator scraped surface heat exchanger and heated to 190°F, then cooled rapidly to about 90°F in a tube-in-shell heat exchanger prior to filling into 5 gallon bottles. All musts were refrigerated at 35°F while 1-3% portions of the musts inoculated with strain 618 *Saccaromyces cerevesiae* were cultured on a flask shaker for 24-48 hours at 75°F. When the inoculum was fermenting vigorously, the must was warmed to about 50°F, inoculated with the shake culture (pitched), fitted with a water trap and allowed to ferment at 70°F for 2 to 4 weeks. When fermentation had ceased, the musts were decanted, the lees (sediment) strained, and the free run wine clarified and filtered. The resulting wines were analyzed for alcohol, dealcoholized brix, pH, and titratable acidity. The raw wine was stored in sealed glass jugs at 70°F for 6 months prior to final clarification, filtration, and bottling, at which time 3 to 5% sucrose was added to obtain an optimum flavor balance as determined organoleptically by a taste panel.

Juice Preparation

The pulpy juice was heated to 120°F and mixed with pectic enzyme preparations, either 0.15 g/l Klerzyme 200 (Wallerstein Labs) or 1.5 g/l Spark L (Miles Laboratory). After standing 3 hours, the warm juice was refrigerated 48-72 hours at 35°F for freezing and storage.

The frozen juice was held 48 hrs at 50°F to thaw then strained, claried and filtered. In 1968, the juices were heated to 190°F in an open steam kettle, filled hot into No. 1 cans, sealed, inverted, held 3 minutes and water cooled to below 100°F, prior to storage at 75°F. The same procedure was followed in 1969, except the heating to 190°F. was accomplished practically instantaneously in the Votator heat exchanger. Samples for concentration were not heated, but introduced into a circulating vacuum evaporator and concentrated to about 60° Brix at temperature below 110°F. Fresh juice was used to cut back to 45° Brix and the resulting concentrate was frozen at −40°F.

Evaluation

The pH, Brix and titratable acidity were obtained on the finished products as described above. Alcohol content was determined from the refractive index of the 100 ml distillate obtained from 100 ml wine in 50 ml water.

Flavor score was assigned to processed products by presenting samples under red light to an untrained taste panel consisting of 8-12 persons. Scoring was on the hedonic scale: 9=excellent, 1=extremely poor. Generally, samples were presented individually except when a direct comparison was desired. All scores reported are averages of 3 replicates, except that wine scores each represent a single replication.

Results and Discussion

Table 1 lists those cultivars evaluated and Table 2 reports data obtained from the freshly crushed juice of all samples observed. The juice yields ranged from 50 to 81% on an as-received basis. Yield was quite dependent upon sample size, handling and processing manipulation, so this figure is a very rough indication of yield potential. Soluble solids and acidity were reasonably consistent within varieties over both sea-

Table 1. Grape cultivars utilized for processing studies.

	Cultivar	Fruit Color
Bunch Grapes	Blue Lake	purple
	Lake Emerald	lt. green
	Norris*	purple
	Stover	lt. green
	W716*	purple
	DS-167	purple
	E11-40	purple
	E12-59*	purple
Muscadine grapes	Bountiful	purple
	Chief	purple
	Hunt*	purple
	Magoon	purple
	Southland	purple
	US 42-12B	purple

*Varieties with asterisk require a pollinator variety nearby for satisfactory fruit set.

Table 2. Characteristics of fresh juice from Florida-grown grape cultivars.

Variety or lines	Processing date	Juice Yield %	Soluble Solids (°Brix)	pH	Titratable acidity as g tartaric acid/100 ml	Remarks
			Bunch Grapes			
Stover	7/18/68	64	17.5	3.4	0.70	bland flavor
"	7/9/69	70	16.3	3.5	0.72	light green with tendency to brown enzymically
Blue Lake	7/25/68	56	15.8	3.4	1.07	deep purple, with
" "	8/1/68	55	15.7	3.6	1.07	distinctive flavor
" "	7/18/69	59	15.7	3.4	1.13	and aroma but turned
" "	7/24/69	54	16.0	3.7	0.99	brown rapidly during handling
716	7/29/68	62	15.6	3.0	1.12	pale red, flat taste
Norris	7/29/68	67	14.8	2.9	1.81	pale red, very tart
"	8/1/68	62	16.6	3.4	1.43	
"	7/28/69	81	17.4	3.5	1.02	red color, excellent flavor
Lake Emerald	7/30/68	51	20.5	3.2	1.55	tart flavor, light green
" "	8/1/68	59	19.8	3.4	1.51	with marked tendency to
" "	7/31/69	64	19.4	3.4	0.87	brown enzymically
E 11-40	7/10/69	50	17.3	3.5	1.01	deep purple, good flavor
D5-167	7/18/69	56	15.2	3.5	0.84	some darkening but mild flavor
E 12-59	7/24/69	50	16.9	3.7	1.12	deep purple, excellent flavor
			Muscadines			
Magoon	9/5/68	64	17.6	2.5	1.09	red, good flavor
"	9/5/68	67	16.9	2.5	1.05	
"	8/20/69	60	15.7	3.2	1.20	
Southland	9/5/68	59	16.6	3.3	0.97	dark red, excellent
"	8/22/69	58	14.2	3.2	1.2	flavor
Hunt, Chief, 42-12B Mix	9/4/68	56	16.3	2.9	0.77	dark red, good flavor
Hunt	8/25/69	54	14.9	3.2	0.92	dark red, good flavor
42-12B	8/22/69	62	15.3	3.0	1.25	dark red, tart flavor
Bountiful	8/25/69	62	14.3	3.3	0.92	dark red, good flavor

sons, with several exceptions. The first lot of Norris grapes in 1968 was 14.8° Brix and 1.8% acid; a picking 4 days later was 16.6° Brix and 1.4% acid. Norris was thus rated as a rather mediocre and tart variety in 1968. However, in 1969 Norris was 17.4° Brix and 1.02% acid; the flavor was excellent. Lake Emerald was consistently highest in Brix, 20.5 and 19.4° in 1968 and 1969 respectively, but acidity was 1.5% in 1968 and only 0.9% in 1969. Such marked changes can partially be attributed to maturity differences, but seasonal influences are also indicated. Since Norris and Lake Emerald ripen later, both are more susceptible to variations in weather from season to season than Stover and Blue Lake. Early varieties usually ripen during sunny weather conducive to low acidity, whereas in some years late varieties ripen during rainy

Table 3. Sensory evaluation of processed juices from Florida grapes.

Variety or line	Season	Product	Sensory Score	Remarks
Concord		Commercial bottle juice	6.95	Standard for comparison of canned juice
Hunt, Chief, 42-12B Mix	1968	Canned juice	6.48	Deep red color and good flavor
Hunt	1969	" "	--	Seemed slightly better than mixed 1968 lot
42-12B	1969	" "	--	Similar to Hunt
Bountiful	1969	" "	--	Similar to 1969 Southland
Southland	1968	" "	5.96	Good color, fair flavor
"	1969	" "	--	Seemed improved over 1968
Magoon	1968	" "	5.81	Deep red, but a little harsh
"	1969	" "	--	Seemed better than 1968 sample
Blue Lake	1968	" "	5.29	Color turned during storage
" "	1969	" "	--	Flavor seemed improved, but color turned
Norris	1968	" "	5.02	Pale red, tart flavor
"	1969	" "	--	Color and flavor seemed greatly improved
Lake Emerald	1968	" "	4.46	Unappetizing brown color and harsh flavor
" "	1969	" "	--	Seemed improved in flavor
Stover	1968	" "	--	Insufficient sample for panel
"	1969	" "	--	Light green, pleasant apple-like flavor
E 11-40	1969	" "	--	Seemed excellent in color and flavor
D 5-167	1969	" "	--	Seemed excellent in color and flavor
E 12-59	1969	" "	--	Seemed excellent in color and flavor
Concord		Sweetened frozen concentrate	7.93	Standard for frozen concentrate comparison
Magoon	1968	Frozen con	7.09	Deep red with good flavor
Southland	1968	" "	6.75	Similar to Magoon
Blue Lake	1968	" "	6.29	Retained good color and flavor
Norris	1968	" "	6.29	Retained good color and flavor

weather conducive to high acidity.

Sensory evaluations obtained for the 1968 processed juice are reported in Table 3. Processing and storage tests are not yet complete on the 1969 crop. Samples of a commercially bottled juice and sweetened frozen concentrate were included for comparison and rated higher than the corresponding experimental samples. Canned juice ranked lower than the corresponding concentrate, probably due to the open kettle sterilization of the juice which provided a variable retention time at 190°F. Although the 1969 canned juices have not been formally rated, it appears that those processed in the scraped surface heat exchanger are of higher quality than the 1968 pack due probably to the faster heating and filling capabilities of the Votator compared to a steam kettle.

The 1968 wines were evaluated after about 6 months storage. They were adjusted to a desirable sweetness level before submission to the panel. There are informal indications that wine quality is still improving in some 1968 samples. The 1969 wine samples have not aged sufficiently for tasting. Table 4 records the sensory properties of the 1968 wines. The flavor score represents

only 1 taste panel carried out at different times on each sample, so no rigorous comparison can be made. The muscadines seemed to possess the best quality, although only Lake Emerald fell below a "like slightly" score of 6. Since discrepancies in brix and acidity were adjusted (based on 1968 results) prior to fermentation in 1969, the resulting wines should be of higher quality.

The mild flavor of Stover and the distinctive color and flavor of the muscadine wines are assets. However, the high acidity of other cultivars together with their generally low brix must be overcome by proper amelioration prior to fermentation and careful ageing and blending before packing. There is a color deterioration problem with Blue Lake which influenced both canned juice and wine, but not the frozen concentrate maintained at −40°F. The same fading has been observed in 1969 processing. In view of the fine deep red color initially present, efforts to define the deterioration and preserve pigmentation are in progress.

In summary, Stover with low acidity and light green color should be appropriate for white wine. All the muscadines examined produced satisfactory juices, frozen concentrates, and red wines as did Blue Lake, (except for the color fading). Norris was not too promising in 1968, but seems of much higher quality in 1969. Because of its large attractive berries, Norris may have potential as a table grape as well as for processing. Lake Emerald is too high in Brix and acid to produce acceptable juice, as well as being subject to rapid enzymic browning during crushing. If low acidity can be maintained, Lake Emerald may be suitable as a wine blend or brandy stock. It is hoped that present breeding efforts emphasizing ease of cultivation, yield, disease resistance, and desirable quality attributes relating to processing (attractive, stable color, full flavor, lower acid, and higher sugars) will result in greater utilization and commercialization of Florida-grown grapes.

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Table 4. Sensory Evaluation of 1968 Wines from Florida Grapes.

Line	% alcohol v/v	Sugar added after fermentation %	Flavor Score	Remarks
Magoon	10.7	4	7.33	Fine flavor, but difficult to clarify.
Hunt, Chief 42-12B Mix	12.4	5	7.00	Fine, light-red, semi-sweet wine.
Southland	13.4	5	6.88	Similar to mixed muscadines.
716	12.8	4	6.85	Good flavor, but poor pale color
Stover	11.9	3	6.70	A fine straw-yellow semi-dry white wine.
Blue Lake	12.8	5	6.70	Good deep red, but color faded after 8 months @ 70°F.
Norris	10.7	4	6.5	Light rosé, rather tart.
Lake Emerald	12.4	4	5.87	Clear amber, too tart.

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RELATIONSHIP OF METHODS FOR RECOVERING ESSENTIAL OIL FROM FRESH CELERY ON THE CHEMICAL COMPOSITION AND FLAVOR

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ABSTRACT

Simultaneous investigations on the chemical composition of celery essential oil, and practical methods for recovering the essential oil from fresh celery in good yield were conducted. Three methods for recovering celery essential oil were investigated. In the first, the essential oil was recovered from celery juice by a vacuum essence recovery technique in yields of 0.5-1.0 ppm. In the second, batches of celery puree were steam distilled and the vapors rectified in a packed distillation column. Yields up to 28 ppm of essential oil were obtained. In the third, the volatiles were stripped from celery puree in a Turba-film evaporator and then rectified in a packed distillation column of different design from the first. Yields up to 30 ppm of celery essential oil that approached the flavor and aroma of fresh celery were obtained. The essential oils were separated into functional groups and analyzed by gas-liquid chromatography. GLC analysis showed a definite difference in composition between the essential oils recovered by the three different methods. The organoleptic properties of the oils recovered by the different methods were quite different.

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INTRODUCTION

Investigations on the chemical composition, and practical methods for recovering the essential oil from celery leaves and stalks were conducted to obtain information in support of celery processing studies. It was necessary to fortify the flavor of dehydrated products because a substantial portion of the volatile flavoring constituents were lost during dehydration.

Gold and Wilson (1, 2, 3) reported the results of chemical composition studies on the essential oil recovered from celery juice by a vacuum essence recovery technique. The essential oil was recovered in yields of 0.5-1.0ppm. Wilson (6, 7, 8, 9) reported on the chemical composition of celery essential oil recovered by batch and continuous atmospheric steam distillation of celery puree (5, 10). Yields of up to 30 ppm of essential oil were obtained.

The subject of this paper is the relationship of essential oil recovery methods to the chemical composition and flavor of the essential oil from celery leaves and stalks.

EXPERIMENTAL

Three methods of recovering celery essential oil were used. In the first, about 5000 kg of celery that had been trimmed of leaves and blanched 4 min in flowing steam was used to obtain approximately 4130 kg of juice which was distilled in a modified continuous vacuum essence recovery unit (1). The juice was flash vaporized under vacuum and the vapors rectified in a distillation column, 2 in. x 4 ft, packed with ceramic Raschig rings. Fractions were collected