Table 2. Effects of ripening and storage on the chemical characteristics of 'Flordaking' peaches of different maturity grades.

Maturity (Color chip)	Storage (days 0°C)	Acidity (% as malic)		Soluble Solids %		SS/TA[z]		pH	
		UR[y]	R[x]	UR	R	UR	R	UR	R
1	0	0.85	0.89	10.7	12.1	12.6	13.6	3.5	3.6
	7	0.91	0.83	12.3	11.8	13.5	14.2	3.5	3.6
2	0	0.85	0.76	11.9	12.8	14.0	16.8	3.5	3.7
	7	0.88	0.79	12.6	13.1	14.3	16.6	3.5	3.6
3	0	0.80	0.82	11.1	13.0	13.9	15.9	3.6	3.7
	7	0.84	0.83	12.8	13.3	15.2	16.0	3.5	3.6
4	0	0.77	0.58	11.6	13.3	15.1	22.9	3.5	3.8
5	0	0.69	0.59	11.0	11.0	15.9	18.6	3.6	3.8
6	0	0.61	—	11.4	—	18.7	—	—	—

[z]Soluble solids—acidity ratio.
[y]Unripened peaches.
[x]Ripened at 20°C and 85% relative humidity.

appearance. Storage was restricted to 7 days because of limited fruit supply. Haller and Harding (5) reported that peaches could be stored for 3-4 weeks at 31-32°F for maximum storage life and ripened at 70°F with good quality. This preliminary study indicates that only 'Flordaking' peaches of chip 4 and greater maturity will have acceptable quality after home ripening. Studies on effect of storage on 'Flordaking' quality currently are underway.

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COMMERCIAL PRODUCTION, PROCESSING AND MARKETING OF MUSCADINE FRUIT JUICE AND DESEEDED CANNED FRUIT

CLIFTON F. SAVOY, LANCE RODAN AND BETSY WOODWARD
Florida Department of Agriculture and Consumer Services
Tallahassee, FL 32399-0800

SOLA LAMIKANRA
Florida A&M University
Center for Viticultural Science
Tallahassee, FL 32307

NATHOLYN HARRIS
Florida State University
College of Home Economics
Tallahassee, FL 32306-2033

KHE VAN CHAU
University of Florida, IFAS
Agricultural Engineering Department
Gainesville, FL 32611

TIMOTHY D. HEWITT
University of Florida, IFAS
Agricultural Research and Education Center
Rt. 3, Box 376, Marianna, FL 32446

CHARLES SIMS
University of Florida, IFAS
Food Science Department
Gainesville, FL 32611

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Abstract. **Developing commercially processed products of muscadine grapes is identified in the 1985 Viticultural State Plan as a primary area for expansion of the grape industry. Two cooperative, interagency pilot projects were initiated between the Florida Department of Agriculture and Consuer Services, Florida A&M University, Florida State University and the University of Florida under the Agricultural Economic Development Policy Act of the State of Florida (Chap. 87-229), which was enacted by the Florida Legislature during its 1987 Session. The projects were conducted to examine the commercial requirements and economics to produce muscadine grape juice and deseeded canned grapes and to conduct storage stability, recipe development and consumer acceptance studies of the resulting products. The muscadine cultivar 'Welder' was used for the juice project while 'Triumph' was used**

in the deseeding/canning project. The resulting single-strength juice was found to have promise as a commercial product after conducting analytical and consumer acceptance tests against existing commercial products. Although the canned grape product has promise as commercially produced ingredients for home baking, further study of the canning process is required.

In the "1984 Florida Viticulture Policy Act" (Chap. 599, F.S.), the Legislature declared that "viticulture, the production and utilization of grapes, is an underdeveloped agricultural commodity enterprise in the State of Florida." The Legislature further recognized that "Florida possesses many resources and geographic advantages that favor the expansion and growth of present day viticulture into a broad-based, economically viable industry. The growth potential of the present industry offers good opportunities for local economic development and supply trade."

In 1985, the Commissioner of Agriculture, in cooperation with a legislatively established Viticultural Advisory Council, submitted a Florida Viticulture Plan to the Legislature (Chap. 599.003, F.S.). Commercial development of value-added muscadine grape products was identified as one of the recommended priorities.

This need was noted again by the President of the Florida Grape Growers Association in his 1987 message to the membership—"Emphasis will again be placed upon the need and desirability of promoting processing facilities for juices, jellies and related products".

The same need also was identified by the Florida Viticulture Advisory Council in its 1986-1987 deliberations, and in its annual advisory report to the Commissioner of Agriculture.

As a result of these prior planning efforts and of the economic potential of the fledgling viticultural industry, further attention came about under the 1987 Agricultural Economic Development Policy Act (Chap. 87-229). This Act was passed by unanimous vote of the Florida Legislature during its 1987 Session.

Muscadine Fruit Juice

Review of literature reveals that there exists considerable scientific information regarding juice production from certain varieties of muscadine grapes, but in-depth, step-by-step, how-to-do-it information relative to commercial scale production is lacking (1-5, 7-9). Therefore, it was decided that a pilot project would be conducted by the Department of Agriculture and Consumer Services in cooperation with other agencies and commercial interests to determine the feasibility of producing, processing and marketing muscadine fruit juice on a commercial scale.

Deseeded, Canned Muscadine Fruit

Review of scientific and commercial literature reveals that little information exists regarding muscadine canning (1, 2, 6, 8, 9). However, it was observed that various pieces of equipment that are similar to those which probably would be needed in a muscadine processing line are in existence in various university and U.S. Department of Agriculture viticultural research facilities and commercial entities located in the Southeast.

Such pieces include among others: harvesting, cleaning/density sorting, deseeding and canning equipment. Collectively, these pieces along with other appropriate pieces could be brought together to form a rough prototype commercial processing line for cleaning and deseeding muscadine fruit. Examination of each piece during actual processing use would aid in determining what modifications need to be made and in determining the overall commercial feasibility.

Therefore, a pilot project to deterine the feasibility of deseeding, canning and marketing muscadine fruit on a commercial scale was conducted by the Department of Agriculture and Consumer Services in cooperation with other agencies and commercial interests.

Materials and Methods

Muscadine Fruit Juice

Muscadine fruit juice (Welder cultivar) was prepared under commercial conditions, transported in a commercial thermol-jacketed tank truck to the bottling plant, and bottled on a mechanical line. A flow chart which describes the various steps in the overall process is provided in Fig. 1.

Laboratory testing of the single-strength muscadine juice was performed to obtain information relating to product quality and storage stability.

Over a period of three months, a total of 48 single-strength muscadine juice samples were analyzed. Three replicates of bottled juice were opened for analysis at 2 week intervals.

The following tests were conducted: a) viable yeast count, b) viable mold count, c) aerobic plate count, d) pH, e) Brix, f) Brix/Acid ratio, g) percent total acidity (as citric acid), h) free sulfite, i) heat stability, j) cold stability, k) accelerated storage examination, and in-house organoleptic survey (comparing to a commercially available white grape juice).

Marketing research was performed to determine information concerning consumer acceptance of the muscadine fruit juice. Tests were conducted at three diverse locations: a rural North Florida town, an urban South Florida city and a service plaza on the Turnpike in Central Florida. Appropriate statistical techniques were incorporated in surveying 235 consumers.

Three types of juice (Welder Muscadine, Welch's Concord Grape and Welch's White) were compared in one test. Each juice was rated on a scale of 1 to 9; with 9 = excellent, 5 = average and 1 = poor.

Deseeded, Canned Muscadine Fruit

Muscadine fruit (Triumph cultivar) was harvested, cleaned, deseeded, prepared for canning, and transported to a commercial cannery where the fruit was canned immediately upon arrival.

There did not appear to be much information available about the temperature and time required for proper heat penetration to kill the possible organisms associated with this type of canning product. Also, the cans could not be filled by gravity flow. Therefore, all cans were heat treated at 250 F, with four batches of 50 cans being exposed to each of the following times: a) 15 minutes, b) 20 minutes, c) 25 minutes, and d) 30 minutes.

Fig. 1. Flow chart for the production of single-strength muscadine juice.

↓ The prepared juice should be kept as cold as possible and away from air during processing (after pressing). All equipment must be clean. The objective: use equipment, facilities and procedures that meet statuatory food grade standards.

Raw Product Description:

↓ Use only clean, sound fruit; harvest at a time that will provide good characteristic muscadine flavor (full-flavored) and aroma, with soluble solids of approximately 14-16% and a titratable acidity of approximately 0.4-0.6% (pH of less than 3.4; adjust pH if necessary). Machine harvest, and collect grapes in appropriate containers (1 or 2 ton bins are standard; use if available).

Postharvest Handling:

↓ Add 100 ppm SO_2 (as potassium metabisulfite) immediately after harvest, and crush fruit within 12 hr after harvest (the closer the vineyard to the processing facility the better for quality control).

Crush: Use any standard commercial stemmer-crusher

↓

Enzymatically Treat:

↓ To increase press yields and improve juice clarity, use pectinase and/or cellulase enzymes (treat as specified on the enzyme package).

Hold at Ambient Temperature:

↓ Approximately 25 C for 1 to 4 hr.

Press:

↓ May be dejuiced in dejuicer prior to pressing. Bladder press would be preferable (gives less suspended solids). Use any available press (screw continuous press or basket).

Make Initial Juice Test:

↓ Taste, pH, soluble solids, titratable acidity, etc.

Cold Settling (24 hrs at –1 to 2 C / 28 to 30 F):

↓ Perform in stainless steel (or other acceptable), jacketed (coolant) tanks or tanks in a large, refrigerated room.

Rough Filter:

↓ Use plate and frame pad filter with coarse pads; Lees filter also good; may need to use diatomaceous earth with filtration system.

Cold Stabilize to Remove Potassium Bitartrate:

↓ Perform at approximately 28 C for the time period needed to stabilize; perform a cold stability test to determine stability.

Perform 2nd Juice Sampling Test:

↓ Taste, soluble solids, pH, titratable acidity, etc.

Adjust Soluble Solids to Acidity Ratio:

↓ Adjust if too sweet to taste; ratio usually approx. 25; adjust using either tartaric acid (natural in grapes) or citric acid.

Determine Protein Stability of Juice:

↓ Perform heat stability test; use fining agents if necessary to stabilize proteins.

Perform 3rd Juice Sampling Test:

↓ Taste, soluble solids, pH, titratable acidity, SO_2 (adjust free SO_2 to approx. 35 ppm).

Fine Filter Juice:

↓ Use plate and frame pad filter with medium to fine pads; an acceptable cartridge system (approx. 0.8 um cartridge) can be used if available.

Add Sorbate Preservative and Sterile Filter:

↓ To approx 150 ppm (as potassium sorbate); use 0.45 um membrane, using a good cartridge filtration system.

Hold Juice at 28-30 F:

↓ A stainless steel transport tanker is to be used to move the sterile processed juice to the bottler. Hold the juice at 28-30 F until bottled (within 48 hours after sterile filtration).

Bottling:

↓ To be performed under near sterile conditions; keep all equipment as clean as possible. 700 gallons are to be bottled in 1 liter (33.8 oz) bottles and 300 gallons in 200 ml (6.8 oz) bottles.

After heat treatment, it was discovered that several of the cans had buckled due to internal pressure from the overfilling of some cans and to filling with cold deseeded muscadine fruit. Therefore, all the cans were kept under refrigeration until laboratory testing and recipe development were accomplished.

A flow chart which describes the various steps in the overall muscadine deseeding and canning process is provided in Fig. 2.

Laboratory testing of the canned muscadine product was performed to obtain information relating to canning procedure, product quality and storage stability. The testing procedures that were utilized are described here in brief detail.

Over a period of three months, a total of 84 samples of canned muscadine fruit (21 from each time interval that the cans were heat treated at the cannery) were analyzed for: a) viable yeast, b) viable mold, c) aerobic plate count, d) pH, and e) Brix. Three replicates of canned fruit from each of the time intervals were opened for analysis at 2 week intervals.

Marketing research was performed to determine information concerning consumer acceptance of cooked foods made from the deseeded, canned muscadine fruit.

Consumer preference testing was conducted at three diverse locations: a rural North Florida town, an urban South Florida city and a service plaza on the Turnpike in Central Florida. Appropriate statistical techniques were incorporated in surveying 235 consumers.

In performing these tests, the deseeded canned muscadine fruit was first prepared as a baked food, and the resulting baked food was tested. A bite-sized sample of muscadine upside-down cake and muscadine nut bread was provided to each consumer. They were instructed to rate the taste of each as either excellent, good, fair or poor. Also, they were asked 1) if they would buy each product if it was available in a store or restaurant, and 2) if they would bake it at home if the ingredients were available.

Fig. 2. Flow chart for cleaning, deseeding and canning muscadine fruit.

Fruit Description:

↓ Use clean, sound fruit that has a soluble solids content of 14 to 16% and a titratable acidity of 0.4 to 0.6%. Machine harvest if possible, and collect fruit in appropriate containers. Transport to processing plant immediately after harvest, and kept cool during transportation.

Cleaning:

↓ Remove leaves, stems and debris by blowing with a strong air blast. Density sort to remove over ripe and unusable fruit, and treat it with 100-150 ppm SO_2 (as potassium metabisulfite). Until processing, store fruit at near 30 F (no longer than 48 hours).

Deseeding/Crushing:

↓ Deseed fruit using a deseeder/crusher. The crushed fruit may require running through the deseeder more than once to remove the seeds.

Syruping Crushed Fruit:

↓ Add corn syrup to the deseeded/crushed fruit to bring the soluble solids level to approximately 25%, and adjust the final pH to 4.3-4.5 if necessary. Transport immediately to the cannery; keep fruit cool.

Hold Syruped Fruit at 30 F or Lower Until Canned:

↓ Syruped fruit should be canned and sterilized within 6 hours after delivery to the cannery. Can the fruit at 250 F for 20 minutes under pressure or at the appropriate time temperature relationship.

Table 1. Analytical test results of the muscadine fruit juice.

Analytical test performed	Resulting observation
Viable Yeast Count as in FDA Bacteriological Analytical Manual, 1984.	All juice samples tested negative for presence of viable yeasts
Viable Mold Count as in FDA Bacteriological Analytical Manual, 1984.	No viable mold was found in any juice sample
Aerobic Plate Count as in AOAC 46.013-46.015	All test results were negative, indicating that microorganisms were absent in the juice
pH	Average pH of the samples examined was 3.31
Brix readings from an Abbe refractometer.	An average Brix value of 14.9 was observed.
Brix/Acid Ratio	The average was a 31.4 ratio.
Percent Total Acidity as in AOAC 22.058.	The average as Citric Acid was 0.476%
Free Sulfite as in the Fed. Reg., Vol 51, No. 131, 1986, . Assoc. Off. Anal. Chem. *69*: 1986.	Range of 39 to 22 ppm over test period. Free sulfite appeared to gradually decrease with a longer storage time. Initial values were 39 ppm; later values approximately 22.
Heat Stability after 24 hours at 55 C	All samples were heat or protein stable.
Cold Stability after freezing, thawing	All samples were found to be cold stable.
Accelerated Storage after 6-8 weeks at 36 C.	All accelerated storage yeast, mold and plate count results were negative.
Additional Tests	A precipitate noted in the juice was tested for potassium, and found to contain 3300 ppm. Protein was tested for; none was detected.
Organoleptic Survey 24 randomly selected participants compared the muscadine juice with a white grape juice made by Welch's. Juices were graded by taste, color and overall impression.	The two juices were nearly equal in terms of participant preference. Out of a total 465 possible points that could be received by either juice, the muscadine juice received 339 points and the Welch white juice received 306 points.

Results and Discussion

Muscadine Fruit Juice

A pleasant tasting muscadine fruit juice was prepared under these conditions, and in general, it has received high remarks from many diverse groups of people in both formal and informal tastings.

With regard to *analytical testing* (Table 1), all the juice samples tested negative for presence of viable yeasts and viable mold, and all analytical indices indicate sufficient acidity to maintain the product.

A flocculent, finely-divided precipitate was noted in the muscadine juice. It contained 3300 ppm of potassium, but no protein. This precipitate did not seem to detract from consumer acceptance of the product.

With regard to *market testing* (Table 2), the muscadine fruit juice was found to compare favorably with similar commercial products now available for purchase. The results reveal that demographics and tourism should be considered in commercial market strategies.

Deseeded, Canned Muscadine Fruit

The deseeded and canned muscadine fruit product for baking/cooking purposes prepared in this pilot project has received good remarks from many diverse groups of people in both formal and informal tastings.

Table 2. Marketing test results of the muscadine fruit juice.

Marketing test performed	Resulting observation
Comparison to Welch's Concord Grape Juice	9% rated muscadine juice equal and 33% rated it better
Comparison to Welch's White Grape Juice	16% rated muscadine juice equal and 47% rated it better
Rankings of the three juices tested (on a scale of 1 to 9)	*1st* is Welch's Concord Juice: 60% and 6.7 (rating above average and mean, respectively) *2nd* is muscadine fruit juice: 39% and 5.8 3rd is Welch's White Grape Juice: 38% and 5.5
Would you purchase the muscadine juice?	56% said "yes."
Response by location	Almost 75% of the rural North Florida consumers stated they would buy the muscadine juice if it was available in a store.
Response by race	More than 80% of the minority consumers stated they would buy the muscadine juice.
Response by age	75% of the consumers 34 years or younger stated they would buy the muscadine juice.
Response by regular juice purchasers	Almost 66% of the consumers who regularly buy juice stated they would buy muscadine juice.
Response by tourists	50% interviewed at a Turnpike Service Plaza expressed they would purchase muscadine juice.

With regard to *analytical testing* (Table 3), none of the cans of muscadine fruit displayed any viable yeast, and only 2 out of 84 samples tested positive for mold. Average Brix value of the canned muscadines was 23.4. Average pH of the 84 samples tested was 3.10.

Since several cans were observed to buckle during the canning process, additional study regarding canning and heat penetration procedures and times are needed. Buckling overstressed the can seams and impuned the product integrity. This is probably the cause of viable molds in several of the cans of the product tested. Florida Food Law considers any food contained in a swollen or buckled can to be adulterated.

With regard to *market testing* (Table 4), the baked goods made from the deseeded and canned muscadine fruit received highly favorable remarks.

Table 3. Analytical test results of the deseeded, canned muscadine fruit.

Analytical test performed	Resulting observation
Viable Yeast Count as in FDA Bacteriological Anal. Manual, 1984, Chapter 19.	No viable yeast was found in any of the cans of muscadine fruit tested
Viable Mold Count as in FDA Bacteriological Anal. Manual, 1984, Chapter 19.	Only in 2 of 84 cans tested was viable mold present. 1 of these was from a 20 min heat treated can; the other from 30 min heat treated can.
Aerobic Plate Count as in AOAC 46.013-46.015 (at 37 C).	No viable microorganisms were found in any of the cans tested. However, viable mold was found in the viable mold test.
Brix as by an Abbe Refractometer.	The average Brix value of the canned muscadine fruit was 23.4
pH	The average pH of the 84 cans of muscadine fruit samples tested was 3.10.

Table 4. Marketing test results of the deseeded, canned muscadine fruit.

Marketing test performed	Resulting observation
Response to the muscadine fruit upside-down cake	43% rated it good and 40% as excellent. 76% would buy it in a store or restaurant. 68% would make it at home.
Overall rating	Test consumers gave it an overall rating of 3.2 on a scale of 1 to 4 (1 = poor, 2 = fair, 3 = good, and 4 = excellent).
Response to the muscadine fruit nut muffins	46% rated it good and 20% as excellent. 60% would buy it in a store or restaurant. 59% would bake it at home.
Overall rating	Test consumers gave it an overall rating of 2.8 on a scale of 1 to 4 (see above).

Conclusions

Muscadine Fruit Juice

From an *analytical standpoint*, the muscadine fruit juice seems to be acceptable. The analytical indices indicate sufficient acidity to maintain the product.

From a *marketing standpoint*, the muscadine juice does not dominate the field; however, it does show promise as a commercial product, especially in rural markets.

Welch's Concord Grape Juice seems to be the standard product on the shelf at the present time, but the data reveal that the muscadine juice can compete against it and also against Welch's White Grape Juice. Results from the organoleptic testing indicate similar results. It appears that sales of this product will be enhanced by identifying speciality market niches.

Deseeded, Canned Muscadine Fruit

From an *analytical standpoint*, the canned muscadine product needs further study to prevent the buckling of the can which happened to several of the cans in this pilot project. This buckling probably is related to the presence of viable molds in two of the test cans.

From a *marketing standpoint*, the deseeded, canned muscadine fruit has promise for this type of processing and commercial sales in that the baked foods, such as the upside-down cake and nut muffins, made from it received high marks of consumer acceptability.

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EFFECTS OF HARVEST DATE, MATURITY AND STORAGE INTERVALS ON POSTHARVEST QUALITY OF RABBITEYE BLUEBERRY (*VACCINIUM ASHEI* READE)

FOUAD M. BASIOUNY AND YULI CHEN[1]
Tuskegee University
Plant and Soil Sciences
Tuskegee, AL. 36088

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Abstract. **'Tifblue' and 'Bluegem' were harvested in mid-June, early, and mid-July. The fruits were stored cold and samples were taken every 15 days to determine fruit postharvest qualties in relation to the stage of ripening. There were gradual decreases in fruit weight and volume which resulted from moisture losses from the fruit. Firmness decreased as a result of ripening but increased under prolonged storage. The internal quality of the fruit was different among the three harvests and among stored samples. Cold storage slightly prolonged the qualities and marketability of the fruit. Early harvested fruits can be stored cold for approximately 30 days without appreciable deterioration.**

Maturity and ripening stages are not accurately defined in the blueberry. In some other fruits, maturation occurs when the fruit reaches full size. Ripening, on the other hand, may be defined as a series of physiological changes that occur in the fruit after maturation which lead to the stage at which the fruit is acceptable to eat. Changes in color have been used by many investigators (2, 5, 7) as an indication of maturity or ripening in the blueberry. Based on that, blueberries are considered ready for eating when the fruit is predominantly blue or at least 75% blue (7). This usually occurs under normal growing conditions from early June to the end of July depending on many factors such as cultivar, environmental conditions, cultural practices and others. This means that commercial harvest of the blueberry may last between 6 and 8 weeks. Individual

[1]Professor of Plant and Soil Sciences and graduate student, respectively.