berm or in weeds averaged 11.8 and 9.0 moths per replication, respectively. Disked nuts yielded an average of 3.8 moths per replication. Emergence from shredded mummy nuts was 0.3 (one nut was found intact following the shredding treatment). Percent recovery from the initial population was low — 5.9%, 4.5% (24% reduction), 1.9% (68% reduction), and 0.2% (97% reduction) for berm, weeds, disked or shredded, respectively, compared with 1991. It is unknown why this discrepancy occurred. In the 1991-1992 winter, rainfall was relatively normal, and temperatures were more moderate than in 1990-1991, when a severe freeze occurred in mid-December following placement of the nuts in the orchard. Interestingly, under laboratory conditions, NOW adult emergence was relatively similar each year.

These results are unlike those obtained for almond, which has a relatively soft shell compared with walnut. Little NOW survival occurred in mummy almonds allowed to remain in a weedy cover throughout winter. Disking also resulted in considerably better NOW mortality in almond than walnut. The thicker walnut shell apparently offers considerably more protection than does the almond shell.

Conclusions

Winter orchard sanitation is essential to NOW management in walnut orchards. However, simply removing mummy nuts from the trees does not destroy overwintering larvae and pupae and prevent subsequent adult emergence. Our data show that adult NOW readily emerge from intact nuts shaken from trees and allowed to remain on a dry, weed-free orchard floor. Shredding mummy nuts following their removal from the trees essentially eliminates all NOW survival. Disking nuts into the soil, or allowing nuts to remain in a weedy cover reduces emergence but does not eliminate it; a few nuts in each situation probably remain exposed and relatively dry, allowing NOW to survive.

Our data offer little flexibility in managing mummy nuts to eliminate NOW overwintering, once nuts are shaken from trees. Shredding remains the best method for ensuring maximum destruction of larvae and pupae in a walnut sanitation program.

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Domestic, world market growing . . .

Grape juice concentrate emerging as a sweetener in juices, food products

Dale Heien ❑ Ray Venner

The domestic and world market for grape juice concentrate is growing. We discuss several options that may enable the San Joaquin Valley's grape industry to capture a larger share of this growth market.

Grape juice concentrate, an emerging growth industry, is used in making grape and multifruit juices and in sweetening food products. Production in California increased to approximately 462,000 tons in 1991, accounting for 28% of the 1991 San Joaquin Valley crush (grape districts 12, 13, and 14, see map). The concentrate, produced by heating grape juice under a vacuum to remove water, competes with apple and other fruit juice concentrates as well as sugar, mainly on a price basis.

San Joaquin Valley grape growers generally view concentrate as a market for surplus grapes, just as wine was once a market for grapes not marketed as table grapes or raisins. Over time the wine market has relied increasingly on wine-specific varietal grapes and on grapes grown in California's coastal areas. Today, the grape juice concentrate market is filling the surplus grape market role. Just as grape production changed in response to wine industry demand, grape production for concentrate could become a primary market for San Joaquin Valley growers. This article examines the prospects and problems in making this transition.

The concentrate market

Grape juice concentrate is diluted into single-strength grape juice and multifruit and sparkling juice. It also sweetens jams and jellies, yogurt, frozen fruit desserts, cereals, cookies and other bakery products. Fruit concentrates are replacing table sugar and corn syrup as many consumers perceive fruit concentrate as a healthier sweetener. Consumers favorably view products labeled "no sugar added." In 1989, when white grape juice concentrate sold for $4.50 a gallon, the costs of grape juice concentrate and table sugar were similar. Now, grape juice concentrate is slightly more expensive.

Sparkling juice sales in the U.S., totaling 37.3 million gallons in 1989, are growing 15% annually. Sales of spreadable fruits are also increasing at the same rate. Demand for products containing fruit concentrate is expected to continue.

U.S. grape juice concentrate is primarily supplied by several varieties grown in the San Joaquin Valley and by the Concord variety in New York and other northern states. Table 1 presents basic U.S. grape juice concentrate production and trade.

The price of grape juice concentrate is strongly affected by the worldwide supply of apple juice concentrate, which accounts for approximately 72% of U.S. fruit concentrate consumption. Apple and grape are close substitutes for multifruit and sparkling juices. Apple juice concentrate prices fluctuate with the level of apple juice concentrate imports and the amount of the U.S. apple crop processed into concentrate. For example, in 1991, the prices of all fruit concentrates rose substantially as fewer apples were diverted into concentrate due to fears surrounding the use of the growth regulator Alar. The price of apple juice concentrate in 1993 plummeted because of bumper apple harvests

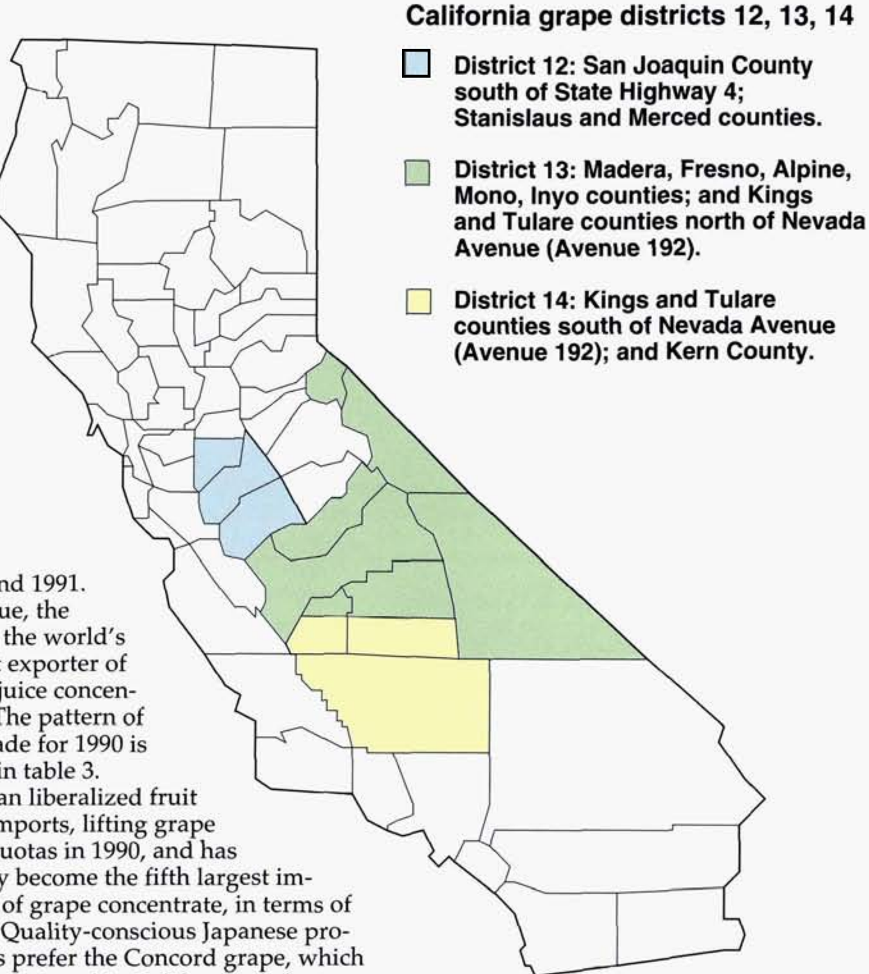

Fig. 1. Varieties grown in grape districts 12, 13 and 14 are candidates for the emerging concentrate market.

in Germany and Eastern Bloc nations, and because a larger share of the U.S. 1992 apple crop was diverted into apple juice concentrate. The price of grape juice concentrate tends to fluctuate with that of apple.

International market. Grape juice is exported in three forms: frozen and unfrozen concentrate, and juice. It is typically sold in concentrated form and processed in the importing nation. The U.S. generally exports higher-value frozen concentrate and grape juice and imports lower-value unfrozen concentrate (table 2). U.S. exports are Concord (*Vitus vinifera*) from northern states and a limited amount of Muscat from the San Joaquin Valley. U.S. exports of grape juice concentrate have steadily risen. Imports increased sharply in 1990 and 1992. (Because we have grouped several varieties produced at different times in different countries, imports and exports may rise simultaneously.)

Argentina supplied 62% of U.S. grape juice concentrate imports in 1990, but its exports have since declined as a result of high inflation, increased domestic wine prices and poor weather. Hail and untimely rains reportedly devastated Argentina's 1993 grape juice concentrate export prospects as well. But other nations, notably South Africa, are boosting their exports to the U.S. and contributed to a record level of U.S. grape juice concentrate imports in 1992.

U.S. apple juice concentrate imports are also becoming less dependent on Argentina. The growing number of important apple concentrate exporters will tend to stabilize the prices of all fruit concentrates.

The value of U.S. grape juice concentrate exports increased rapidly to $43.7 million in 1989 and declined slightly in 1990 and 1991. By value, the U.S. is the world's largest exporter of grape juice concentrate. The pattern of this trade for 1990 is given in table 3.

Japan liberalized fruit juice imports, lifting grape juice quotas in 1990, and has quickly become the fifth largest importer of grape concentrate, in terms of value. Quality-conscious Japanese processors prefer the Concord grape, which is not produced in California. Before trade liberalization, Japan favored U.S. exporters to lessen their trade surplus with the U.S., but the import liberalization in 1990 enabled Japanese fruit processors to choose more freely. As a result, although Japanese grape juice concentrate imports increased, the percentage from the U.S. declined from 95% in 1989 to 64% in 1991. U.S. grape juice concentrate exporters benefited from Japan's lifting of import quotas, but they were harmed by losing preferential treatment. Overall, U.S. grape concentrate exports to Japan rose as Japan's increasing level of imports offset the declining U.S. share.

The European Economic Community (EEC) markets for fruit concentrates are currently of limited interest because of EEC trade barriers. EEC's customs duties for fruit concentrates are up to 50% of their value for non-EEC exporters. Nearly all EEC concentrate imports are from other EEC nations. Japanese and Canadian markets will likely remain the primary markets for U.S. grape juice concentrate exports. South Korea is expected to eliminate import restrictions on grape concentrate in the 1995-1997 liberalization program. Other East Asian nations are also expected to increase imports.

The International Trade Centre (ITC) has concluded that the fruit juice business will remain a growth industry for a long time. Per capita consumption of fruit juices and nectars is still fairly low in most markets. Consumption of fruit juices is projected to increase due to greater health consciousness. Innovative packaging by bottlers and retailers, coupled with advertising and aggressive promotion, will also increase consumption. Fruit concentrates are increasingly used in other food and beverage products, including dairy products and health drinks. The ITC estimates that the world market for fruit juices will grow strongly in the future.

TABLE 1. U.S. grape concentrate: production, exports, imports and consumption

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
	Quantity (68° Brix)										
	1,000 tons										
Calif. prod.				350	350	350	400	450	450	462	652
Imports	12	20	53	59	61	41	87	136	235	151	330
Exports	58	53	51	43	47	58	83	98	110	101	107
Imp.minus exp.	-46	-33	2	16	14	-17	4	38	125	50	223
Concord total	373	457	408	316	334	458	360	390	337	431	434
U.S. consumption				682	698	791	764	878	912	931	1,309
	Value										
	$ million										
Imports	2.3	2.1	4.0	4.9	6.7	5.6	10.5	16.4	27.3	20.1	61.6
Exports	15.8	13.8	11.0	10.6	11.9	17.4	22.1	43.7	46.3	40.5	43.1
Imp.-exp.	-13.5	-11.6	-7.0	-5.7	-5.2	-11.8	-11.6	-27.3	-19.0	-20.4	18.5

Sources:
California grape juice concentrate (GJC) production:
Cavanaugh, Pat, "Concentrate Imports Up." *Grape Grower,* February 1991, p. 10. (1985-1990).
California Association of Winegrape Growers (CAWG), 1991 and 1992 estimates.
Concord grape production:
U.S. Department of Agriculture, National Agricultural Statistics Service. *Noncitrus Fruits and Nuts 1991 Preliminary*, January 1992.
Note: Total Concord grape production slightly overstates the amount processed for grape juice concentrate.
U.S. GJC Exports and Imports:
U.S. Department of Agriculture, Economic Research Service. *Foreign Agricultural Trade of the United States*, 1990 and previous editions.
U.S. Department of Commerce, Bureau of the Census. *U.S. Exports of Merchandise,* Disk. (1990-1992)
U.S. Department of Commerce, Bureau of the Census. *U.S. Imports of Merchandise,* Disk. (1990-1992)
The Department of Commerce reports grape juice concentrate imports and exports at 21° Brix. These figures were multiplied by 21/68 to convert imports and exports to 68° Brix. ° Brix refers to soluble solids, or percentage sugar by weight.
Quantity is the sum of 68° Brix concentrate plus the amount in grape juice. (Conversion ratios are 1.0 gallons of concentrate per 4.25 gallons of grape juice, and 40 gallons of concentrate per ton of grape crush).
Value is Customs Value, the value of imports as appraised by the U.S. Customs Service for duty levying purposes.
U.S. grape juice concentrate consumption approximately equals San Joaquin Valley grape juice concentrate plus total Concord production plus imports minus exports.

TABLE 2. 1991 U.S. grape juice concentrate exports and imports

Grape juice and concentrate	Exports Quantity	Exports Value	Imports Quantity	Imports Value
	million gal	*$ million*	*million gal*	*$ million*
Not concentrated	4.2	6.1	0.1	0.3
Conc., frozen	5.0	14.0	2.4	3.0
Conc., not frozen	7.0	20.4	17.2	16.8
TOTAL	16.2	40.5	19.7	20.1

Sources:
U.S. Department of Commerce, Bureau of the Census. *U.S. Exports of Merchandise,* December 1991, Disk.
U.S. Department of Commerce, Bureau of the Census. *U.S. Imports of Merchandise,* December 1991, Disk.

TABLE 3. U.S. concentrate imports and exports, by country

1990 U.S. grape concentrate imports, by percent of value

Argentina	Brazil	Chile	Mexico	Other nations
62.0%	21.2%	6.5%	3.8%	6.5%

1991 U.S. grape concentrate exports, by percent of value

Japan	Canada	Other nations
45%	41%	14%

Source: Kortbech-Oleson, R., The World Market for Grape Juice. International Trade Centre UNCTAD/GATT. Prepared for: Food and Agriculture Organization of the United Nations, March 1992.

Enhancing concentrate sales

In this section, we discuss the avenues open to industry to increase demand for grape juice concentrate and to make it more competitive with other concentrates.

1. Develop red and white grape varieties for concentrate use, to replace the currently used winegrapes and Thompson Seedless. Grape varieties have traditionally been selected for uses other than concentrate. For example, Thompson Seedless, Chenin Blanc and French Colombard are crushed for white grape concentrate. An ideal white concentrate variety is high yielding with a neutral taste, like Burger and perhaps Tokay. Properties of an ideal single-strength white juice grape variety are: (1) low level of phenolics for minimal color development, (2) low pulp level for good yield, (3) machine harvestability, (4) ease in pressing, (5) no aroma, (6) neutral taste and (7) high yield. An ideal red grape variety would share many of these qualities, but it would also contain dark red pigment, which might be genetically engineered.

2. Investigate viticultural practices to lower the cost of production for grape concentrate. Winegrape growers seek the optimal tradeoff between yield and wine quality, and have been supported by substantial viticultural research. Growers marketing grapes for concentrate attempt to maximize sugar content and do not need to consider wine quality. But they generally follow the same viticultural practices as growers marketing grapes for wine. Growers for concentrate have little guidance on fertilizing, pruning and trellising to produce grape sugar at the lowest cost.

Also, one niche market may be harvesting grapes early, at 12° to 14° Brix, so that they can be fresh squeezed into 100% grape juice ready to drink. This could apply to certain varieties, such as Muscat.

3. Standardize grape solids into precise uniform grades. Food processors use Statistical Process Control to precisely measure basic functional and chemical properties and their variations. Processors insist that ingredients have a uniform quality and prefer to use corn fructose as a sweetener because it contains a fructose level to a precise specification. In comparison, technology has not been developed to create uniform grades of grape concentrate.

Also, different concentrate specifications are desirable for different food products. The shift in consumer preference toward fruit sweetener may justify creating concentrates specific to food products. According to industry experts, concentrate could be used in any application calling for sugar or corn syrup. Grape juice is a much more complex system than sugar or corn syrup. Issues of pH, SO_2, tannins, phenolics, dextrose/fructose ratios and microbial content all cause interactions in mixed fruit systems that have to be empirically explored. Also, variations in characteristics, such as titrable acidity, pH and color, could be exploited to develop market niches for grape juice concentrate. Establishing several uniform grades would enable processors to select the best grade for their food product.

Research on grape juice could also increase the demand for grape concentrate. For example, the U.S. Department of Agriculture's Agricultural Research Service (USDA/ARS) has developed four grades of pear juice by clarity. Pear concentrate is also combined with other fruit concentrates in multifruit juices. The pear industry now has a decolorized, deflavorized, deodorized, generic fruit sweetener with varying levels of pear solids. ARS has not developed similar sweeteners with varying levels of grape solids.

4. Generically promote grape concentrate, especially to the cereals and bakery sectors. Technical data, as well as recipes substituting grape solids for sucrose in selected food areas, could be produced. An information package could be assembled to show selected food processors how grape concentrate can be used in their products. Little information is currently available on how to substitute grape juice concentrate for sugar. Cereals and baked products represent growth opportunities; only recently have fruit concentrates been substituted for table sugar and corn syrup. The complex nature of grape concentrate makes conversion difficult. For example, grape concentrate contains more tartaric acid than corn syrup, so bakery producers must be able to consistently offset the added acidity. This program would be targeted at food processors and not consumers.

A relevant example is the honey industry, which assists food processors in converting from sugar to honey with a program employing technicians who compile properties, research applications and offer problem-solving assistance to honey users.

5. Promote San Joaquin Valley grape concentrate sales abroad. Exports are enhanced for many agricultural commodities through participation in the USDA, Foreign Agricultural Service (FAS) Market Promotion Program (MPP) and Export Incentive Program (EIP). Selected commodities receive FAS funding for generic and brand promotion overseas and developing recipes in foreign languages. For example, the Concord grape industry received $1.4 million in 1991 from the FAS to promote Concord products overseas.

The Centurian grape variety is a candidate for grape concentrate because it is high yielding, high in acid and high in sugar. *(Photo by Harold Olmo)*

6. Petition to earmark proceeds from the $1-per-gallon duty on grape concentrate imports for research and generic promotion. This would be similar to the Florida Citrus Growers' use of excise tax revenues from orange juice imports. San Joaquin Valley's grape concentrate industry may be discouraged from collective promotion, because exporters of concentrate to the U.S. would not contribute to the promotion but would benefit from the increased demand. Florida citrus growers faced a similar situation. They generically promoted oranges and orange juice concentrate. Promotion boosted demand, but much of the increase in sales was supplied by cheaper imported orange juice concentrate from Brazil. Because Brazil and other nations benefited from the promotion but did not contribute, Florida exacted an equalizing excise tax on imported citrus products in 1970. By 1984-85, revenue from this excise tax accounted for 33% of total orange excise taxes and was used to pay for 30% of Florida's generic citrus advertising expenditures.

The U.S. $1-per-gallon duty charge on imported grape concentrate generated $3,276,033 in revenue in 1991. The San Joaquin Valley concentrate industry could petition that at least part of the import duty be used to fund generic promotion. The petition would be more likely to succeed if the industry were already collectively promoting and researching, as was the case with the Florida Citrus Growers.

Industry organization

San Joaquin Valley's grape concentrate industry is not organized to implement programs outlined here. In response, several valley grape growers have formed the California Fruit Juice Growers (CFJG), a voluntary organization of grape, apple and pear producers whose fruit is crushed for concentrate. As an alternative, other commodity groups have enacted commissions to ensure that all industry members contribute and that profitable research and marketing may be supported. The programs mentioned here cannot be implemented without active industry participation.

Conclusion

Grape concentrate is a growing market, thanks to an innovative industry and consumer preference for fruit sweeteners over table sugar. Grape concentrate is diluted into grape and other fruit juices, and also sweetens a limited but increasing number of food products. World grape juice concentrate trade is competitive, but growing. There are several options for San Joaquin Valley grape growers to capture a larger share of the fruit concentrate market. These options include developing new varieties and viticultural practices suited for concentrate, developing precise, uniform grades for concentrate and engaging in generic and export promotion that broadens industry understanding of how concentrate may be used. Enacting these and other options may enable grape concentrate to join table grapes, raisins and wine to become the fourth primary market for California grapes.

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