

November 1995

FRUIT JUICE ADULTERATION

Detection Is Difficult, and Enhanced Efforts Would Be Costly



**Resources, Community, and
Economic Development Division**

B-265983

November 3, 1995

Congressional Recipients

Nationwide, school districts serve over 56 million gallons of fruit juice annually. Some members of the fruit juice industry expressed concern that fruit juice served in the federal school meal programs may be adulterated with cheaper ingredients and may not be accurately labeled. Several well-publicized prosecutions have led to the conviction of processors for adding cheaper ingredients—such as water, sugar, and other adulterants—to juice products marketed as 100-percent-pure juice.

Consequently, the Congress mandated, in the Healthy Meals for Healthy Americans Act of 1994, that we review the costs and problems associated with the sale of adulterated fruit juice to the school meal programs. Subsequent discussions with your offices refined the scope of the mandate into the following questions:

- What are the nature and extent of the juice adulteration problem in the federal school meal programs, and can current inspection and testing methods detect adulteration?
- What recent federal enforcement actions have been taken against juice adulterators, and what was the magnitude of the fraud?
- What are the options for enhancing the detection of juice adulteration, including inspections for juice plants that sell their products to the federal school meal programs?

Results in Brief

Unscrupulous juice processors can gain an economic advantage over legitimate processors by adding less expensive ingredients—such as water and sugar—to juice and labeling the resulting product as pure. The extent to which fruit juice adulteration takes place is uncertain, however, because it is difficult to detect. Inspections of juice plants are not designed to detect adulteration, and current laboratory tests have limitations. Estimates of the problem's extent vary widely for orange juice and apple juice, the two most frequently consumed juices. Government and industry officials believe that the rate of adulteration for apple juice is insignificant, but estimates of the rate of adulteration for orange juice range from 1 to 20 percent.

Since the mid-1980s, the Department of Justice has prosecuted seven cases of juice adulteration. These prosecutions resulted in six convictions

and one acquittal. Federal prosecutors conservatively estimated that the magnitude of the fraud for the six successfully prosecuted fraud cases ranged from \$2 million for the smallest case to \$37 million for the largest case. On the basis of these convictions, the U.S. Department of Agriculture has taken debarment actions against the three companies that remain in operation and against 21 individuals to prevent them from selling juice to the school meal programs.

Government and industry officials identified two primary options for enhancing the detection of adulterated juice sold to schools—conducting in-plant inspections and instituting either systematic or risk-based juice-testing programs. While these methods could enhance efforts to detect adulterated juices, they would be costly.

Background

Over the years, several methods for adulterating juice have been used. Adulteration ranges in sophistication from simply diluting juice with water to adding beet sugar, the adulterant that is most difficult to detect. Introducing these ingredients is not illegal; however, knowingly selling the resulting product as pure juice constitutes fraud. Processors can increase their margin of profit or undercut competitors' prices to increase sales by adulterating juice and selling it as 100-percent-pure juice.

Although these types of adulteration provide an economic advantage (and are therefore referred to as economic adulteration), they pose little threat to the public's health and safety. The nutritional benefits of adulterated juices are generally similar to those of their pure counterparts, and the adulterated products are usually considered harmless except for customers who are allergic to a substituted ingredient.

Orange juice and apple juice are the most widely purchased juices for the school meal programs, as well as for consumption nationwide. For example, orange juice represents almost 45 percent of the fruit juice served by schools. For the 1994 school year, schools purchased over 98 percent of the juice they served directly from vendors, obtaining the remainder through one of the U.S. Department of Agriculture's (USDA) commodity distribution programs.

Two federal agencies—the U.S. Department of Health and Human Services' Food and Drug Administration (FDA) and USDA's Agricultural Marketing Service (AMS)—have primary responsibility for ensuring the quality and safety of the fruit juice served in the federal school meal

programs. A third federal agency, USDA's Food and Consumer Service, is responsible for setting minimum nutrient requirements for the meals served in the school meal programs. In addition, the Department of Justice (Justice) prosecutes companies and individuals suspected of adulterating fruit juice products.

FDA has oversight and regulatory responsibility for domestic and imported food products sold in interstate commerce. To ensure that foods are safe, wholesome, and honestly labeled, FDA monitors the food industry, including fruit juice processors, by periodically inspecting production facilities and occasionally sampling and testing products. FDA's standards identify the sweeteners that may be added and specify certain labeling requirements and maximum levels of water (expressed as minimum solid contents) that juice may contain. FDA investigates companies suspected of violating these standards and refers cases to Justice for criminal fraud prosecutions.

AMS has responsibility for inspecting and grading food products. The agency grades the quality of juice on the basis of such factors as appearance, color, flavor, aroma, and defects, as well as the level of water, acid, and oils in the juice. AMS grades products sold to USDA's commodity programs and provides fee-for-service inspections to companies that want AMS to certify other food products. However, there is no federal requirement that AMS inspect or grade the juice that schools purchase directly from vendors for the school meal programs.

The Food and Consumer Service has responsibility for administering the child nutrition programs sponsored by USDA. The agency subsidizes the cost of school meals and sets nutritional standards for the meals. These standards require schools to serve fruit, vegetables, or pure fruit juice on a regular basis. Although schools may serve "juice drinks" that are less than 100 percent juice, only pure juice meets the standards for nutrients established by the Food and Consumer Service. For example, to satisfy the school breakfast requirements, schools may serve a 1/2-cup portion of 100-percent-pure juice. Serving a 1/2-cup portion of 50-percent-pure juice would satisfy only half of the breakfast requirements. The agency also distributes federal commodities, including a relatively small amount of juice, to schools.

To protect the government's interests in the event that a vendor has been convicted of fraudulent practices, such as juice adulteration, the Food and Consumer Service has the authority to administratively suspend for up to 1

year or debar for up to 3 years a company or individual from selling to the government or government programs, such as the school meal programs.

Justice's Office of Consumer Litigation and U.S. Attorneys' offices prosecute fruit juice processors for violating federal fraud statutes. The Office of Consumer Litigation also forwards information on convicted companies and individuals to the Food and Consumer Service for possible debarment actions.

Adulteration Is Difficult to Detect, and Its Full Extent Is Unknown

The extent to which fruit juice purchased under the federal school meal programs is adulterated cannot be determined precisely at this time. Generally, AMS' and FDA's inspections are not designed to detect economic adulteration, and current tests cannot effectively detect adulteration at levels below 10 percent. In addition, schools do not take steps to determine whether the juice they purchase is adulterated. Although comprehensive data are not available, industry officials believe that the adulteration of apple juice is insignificant. However, on the basis of the testing that has been conducted for orange juice, FDA, USDA, the Florida Department of Citrus (FDOC), and private laboratories estimate that 1 to 20 percent of the supply is adulterated.

Inspections and Tests Have Limitations

AMS' inspections are designed to grade the product, and FDA's inspections are designed primarily to identify unsanitary conditions in food-processing plants. These agencies do not routinely inspect all U.S. juice-processing plants, which number over 500. Most inspections do not include tests for adulteration. Moreover, the tests for adulteration performed by these agencies and by private laboratories have limitations, and most are expensive.

Current Federal Inspection Programs Are Not Likely to Detect Adulteration

AMS' inspections are not designed to detect adulteration, but rather to grade products in accordance with AMS' standards. Lot inspections, which look only at juice and not at a plant's operations, can allow illegal activities, such as adulteration, to occur in the plant without being observed by the inspector. According to AMS officials, even during an in-plant inspection, which looks at both juice and a plant's operations, an inspector can identify adulteration only if a company is blatant in its actions and the inspector observes unusual piping arrangements or substances commonly used as adulterants. AMS' inspections are mandatory only for juice produced for USDA's commodity distribution programs and

for juice processed in Florida.¹ Therefore, many juice processors in the United States do not have their products inspected by AMS. In fiscal year 1995, for example, AMS inspected the operations and juice products of 130 plants.² (See app. I for additional information on AMS' inspection services and costs.)

AMS officials told us that the routine tests done to grade juice products, such as determinations of acid levels and solid contents, might identify some potential adulteration. However, these officials emphasized that such tests are not designed to identify potential adulteration. In a special agreement with the state of Florida, AMS also tests frozen concentrated juice coming into the state for economic adulteration, among other things. However, this juice accounts for only 15 percent of the juice processed in Florida.

FDA's inspections of juice plants are likewise not specifically designed to detect the economic adulteration of juice. These inspections are instead done primarily to determine if a juice plant engages in good manufacturing practices. As a result, such inspections focus on sanitary conditions at the plant, as determined primarily by the inspector's visual observations.³ Furthermore, FDA does not inspect all juice plants each year. From 1992 to 1994, FDA inspected no more than 20 percent of the nation's over 500 juice plants in any one year. In fiscal year 1992, FDA (and its contractors) inspected 77 juice plants; in fiscal year 1993, 70 plants; and in fiscal year 1994, 102 plants. Although FDA can test juice for adulteration at several of its laboratories, FDA officials told us that juice samples are not routinely collected for analysis. If an inspector observes something suspicious that might indicate a product is being adulterated, products may be selected for laboratory analysis to determine whether they comply with FDA's standards for fruit juice. For example, adulteration was detected by one inspector who happened to observe an employee adding other ingredients to orange juice.

Even the presence of inspectors in the plant during processing does not preclude adulteration. Two companies convicted of adulterating juice since the mid-1980s had their juice inspected by AMS and FDA while they were adulterating it. One company had been adulterating juice while AMS

¹Florida Citrus Code 601.27 requires that all citrus juice products packed in Florida be inspected and graded. AMS inspects these products under a cooperative agreement with the state.

²The 130 inspections conducted by AMS in fiscal year 1995 include both voluntary and mandatory inspections.

³In May 1995, FDA issued a guide for juice inspections, which is intended to assist investigators in identifying juice adulteration as part of their sanitary inspections of juice plants.

was inspecting its plant and certifying its juice as USDA Grade A. The adulteration went undetected because it occurred at night when the AMS inspector was not in the plant. The company also passed an inspection by FDA during the same period. Another company was also inspected by AMS and FDA but evaded detection by elaborately modifying the structure of its plant to hide a sophisticated piping system through which beet sugar was added to orange juice.

Laboratories' Testing Capabilities Are Limited, and Tests Are Expensive

With today's testing technology, it is not possible to detect all adulterants in juice. Most experts agree that current tests cannot effectively detect adulteration levels below 10 percent. Tests that examine the sugars in the juice to determine their authenticity appear to be the most sensitive. These tests can generally detect adulteration rates as low as 10 to 20 percent.

Government and industry experts agree that a battery of tests is needed to verify that nothing has been added to or substituted for pure juice. The costs of analyzing juice samples for adulteration range from \$15 for a basic test to identify dilution with water, to \$700 for a test to identify the presence of pure beet sugar. A battery of tests to detect adulterants in orange juice and apple juice, excluding the most sophisticated test to detect pure beet sugar, can cost from \$450 to \$800. Currently, only a few government and private laboratories in this country can conduct such a complete analysis for authenticity, and the most sophisticated test used to detect beet sugar is not currently available in the United States. (See app. II for additional information on tests and costs.)

Schools Do Not Test Juice

Few if any school districts take steps to ensure that the juice they purchase is free from adulterants. Food and Consumer Service officials told us that schools rely on government regulators and assume that juice processors are complying with federal and state laws. Sixteen of the 18 school districts we contacted required 100-percent-pure juice to meet the Food and Consumer Service's nutritional standards, but none of these districts took additional steps to ensure that the juice they purchased met this specification. Instead, the schools relied primarily on the integrity of the vendor and the product label. Six districts also required that their juice be graded by AMS to further ensure its quality.

Estimates of Juice Adulteration Rates Vary

Estimates of the extent to which juice is adulterated vary according to the kind of juice and the type of customer. Government and industry experts said that in their experience, adulteration rates for apple juice are

insignificant. However, estimated rates of adulteration for orange juice (based on limited testing by government and private laboratories) range from a low of 1 percent for juice sold in the retail market to as high as 20 percent for juice sold to institutions, such as schools. The lower end of this range comes from retail and institutional testing by AMS' and FDOC's laboratories. For example, FDOC found that about 1 percent (16 out of 2,503) of the juice samples that it tested from August 1992 to April 1995 were adulterated.

The higher end of the range comes from testing by private laboratories and FDOC of juice sold in the institutional market. For example, FDOC found, under its program for monitoring adulteration, that from August 1992 to April 1995, 18 percent of the samples destined specifically for the institutional market were adulterated. Government and industry experts believe that the institutional market, which is generally the source of juice for the school meal programs, is more vulnerable to adulteration than the retail market because juice is less likely to be tested in this market. (See app. III for more information on estimates.)

According to government and industry experts, the incentive for adulteration increases when the price of orange juice rises. FDOC's monitoring program found, for example, that when juice supplies were down because of the freezes during the early 1980s, orange juice was extensively adulterated with pulpwash and diluted with water.⁴ In 1981, 50 percent of the samples analyzed in accordance with Florida's standards were adulterated with pulpwash, and in 1984, 32 percent were diluted with water. FDOC officials attributed the high adulteration rates to the reduced supplies of frozen concentrated orange juice and higher prices, which created an economic incentive to adulterate orange juice.

In contrast, the supply of concentrated orange juice is currently high, and the prices for it are low. Industry figures show that the total volume of domestically produced and imported orange juice increased by 31 percent from 1990 to 1994. During the same period, the annual average price of frozen concentrated orange juice decreased by 41 percent. Hence, FDOC officials believe that the incentive to adulterate has decreased and the level of adulteration is comparatively low.

⁴Pulpwash is created by extracting soluble fruit solids from orange pulp with water. Florida's standard of identity, which defines what may be included in "frozen concentrated orange juice," has prohibited the addition of in-line pulpwash (i.e., pulpwash that comes from the same fruit as the juice) to the product. In contrast, FDA's standard of identity for the same product permits the addition of in-line pulpwash. The federal standard permitting the addition of pulpwash now prevails, since, under the Nutrition Labeling and Education Act of 1990, federal standards of identity preempt state requirements that are not identical to federal standards.

Federal Enforcement Actions Have Been Successful

Since the mid-1980s, Justice has successfully prosecuted six of seven fruit juice adulteration cases. These successful actions resulted in fines and settlements of more than \$11 million and prison sentences for company employees of up to 104 months, as table 1 shows. Collectively, 32 employees were convicted of felonies or misdemeanors. Federal prosecutors believe that the fruit juice industry is less subject to fraud today than it was 10 years ago because of the publicity surrounding these prosecutions and the significant prison sentences imposed by the courts.

Table 1: Summary of Federal Convictions for Adulterating Fruit Juice

Name of company	Year sentenced	Magnitude of fraud ^a	Fines and prison sentences ^b	
			Cumulative fines	Range of prison sentences (in months)
Apple Valley International, Inc.	1993	\$2,100,000	\$580,000	0
Beechnut Nutrition Corp.	1989	5,000,000 ^c	2,435,155	0-12
Bodines, Inc.	1990	37,000,000	450,000	0-24
Paramount Citrus Association	1993	1,980,000	6,900,000	0
Peninsular Products Co. and Flavor Fresh Foods Corp. ^d	1993	10,300,000	622,000	0-60
Sun Up Foods, Inc.	1994	22,000,000	200,000	0-104
Total:			\$11,187,155	

Note: Only recent fraud convictions by Justice are included.

^aThe magnitude of fraud accepted by different courts is not comparable because estimating procedures vary.

^bFines are cumulative for companies and employees; the range of prison sentences for company employees excludes probation.

^cThe magnitude of fraud is based on the value of the adulterated product in Beechnut's inventory when the fraud was discovered.

^dFlavor Fresh Foods Corp. and Peninsular Products Co. were jointly involved in a single fruit juice adulteration case.

Source: Justice's Office of Consumer Litigation.

Estimates of the magnitude of the fraud associated with the individual prosecuted cases ranged from about \$2 million to \$37 million and represent the difference between the processor's costs for pure juice and for adulterated juice. However, these estimates may understate the true

magnitude of the fraud because they are based on available company records, which may be incomplete. For example, prosecutors said the adulteration scheme in one case probably began in 1979, but the \$10.3 million estimate of the fraud's magnitude was based on company records that were available only from 1985.

In addition, since prosecutors base these fraud estimates on reduced costs to producers, the ultimate impact on customers is not known. Instead of using differences in retail prices, prosecutors use differences in the cost of ingredients to estimate the magnitude of the fraud because they generally lack complete information on who purchased the juice and at what price. Prosecutors said the impact on customers is further obscured by the widespread practice of repackaging and distributing adulterated juice products under several brand names at different prices. For example, adulterated concentrated juice in one fraud case was sold over a period of several years under more than 20 brand names in at least 29 states.

The Food and Consumer Service has initiated debarment actions against companies or former employees in four of the six successfully prosecuted cases. Collectively, it has debarred or is debarring 21 individuals associated with these cases and all three companies that remain in operation. Debarment actions were not taken in two cases prosecuted before the agency was authorized to take such actions in March 1989.

Enhancing Detection Would Increase Costs

Government and industry officials identified two primary options for enhancing the detection of adulterated fruit juice: conducting in-plant inspections and instituting a juice-testing program. Officials agree that inspections alone, no matter how comprehensive, cannot effectively identify juice adulteration. Most experts believe that juice testing, used in conjunction with definitive purchasing specifications for juice, would enhance the ability of the federal government and school districts to detect adulterated juice. Both of these options, however, would be costly.

In-Plant Inspections

Industry officials have proposed that all processors selling juice to schools for the federal school meal programs be subject to in-plant inspections by USDA. Under these inspection programs, inspectors would be located in the plants to observe processing and packaging operations and to sample juice for use in grading the product. The presence of such an inspector might serve as a deterrent by making it more difficult for adulterators to receive

shipments of adulterants, store them on the premises, and add them to the juice during processing.

However, as previously mentioned, in-plant inspections are costly and do not always detect adulteration. USDA's inspections would be labor-intensive and, according to the agency, would require it to hire at a minimum between 30 and 40 more staff. These inspections, charged to the juice processor, cost about \$40 per hour. For example, USDA's in-plant inspections currently cost one plant selling a medium volume of juice (i.e., about 250,000 gallons) destined for schools about \$8,538 per year. Some industry and government officials believe the added costs would place an unfair burden on small juice companies with fewer resources. A portion, if not all, of these added costs would likely be passed on to the school districts in the form of higher juice prices.

Testing

Alternatives to observations made by in-plant inspectors are systematic or risk-based programs for testing fruit juice sold to schools. Many experts believe that school purchase contracts with definitive specifications for juice, combined with either of these two forms of testing, would reduce the likelihood of schools' purchasing adulterated juice. Systematic and risk-based juice-testing programs differ significantly in that systematic programs test a set number of samples at a set frequency, while risk-based programs vary the number of samples and the frequency of the testing with the estimated risk. Since the number of samples and the frequency of the testing can be reduced when the risk is thought to be low, programs based on specific risk factors tend to be less expensive than systematic programs.

Under a risk-based testing program, school purchase contracts would include definitive specifications for juice and a provision for random testing that would form the basis for rejecting substandard juice. Such an approach would call for increasing the frequency of sampling and testing when certain high-risk factors were present. High-risk factors could include bids that were significantly below market; suspicious results from federal, state, or other monitoring programs; referrals from industry; or unusually high prices for concentrated juice that would presumably increase the economic incentive to adulterate juice.

Although testing against juice specifications could reduce a school district's risk of buying adulterated juice, such testing would likely increase the cost of juice significantly. For example, the cost of purchasing

fruit juice for the 1993-94 school year in the school districts we examined ranged from \$7,600 in a small district to \$240,000 in a large district. According to our calculations, the annual cost of testing for that period would have averaged about \$6,400 per district if each district had tested only one sample of juice each quarter.⁵ Thus, for that 1-year period, the cost of testing in the small district would have been almost 84 percent of the entire cost of purchasing the juice. Many officials believe that if industry were required to incur the cost of testing, this cost would most likely be passed on to schools in the form of higher juice prices.

The federal government would also incur additional costs in implementing and administering such testing programs. Such costs would include those that the Food and Consumer Service and FDA would incur in developing a set of definitive juice specifications, disseminating these specifications to the school districts, and educating the districts about the new testing program. Because of the many factors involved in these actions, we did not attempt to determine these costs.

Agency Comments and Our Evaluation

We provided copies of a draft of this report to AMS, the Food and Consumer Service, FDA, and Justice. We met with AMS' Deputy Director, Science Division, and Deputy Director, Fruit and Vegetable Division; the Food and Consumer Service's Branch Chief, Program Analysis and Monitoring Branch, Child Nutrition Division; and FDA's Director, Executive Operations and Consumer Safety Officer, Office of Plants, Dairy Foods and Beverages, Center for Food Safety and Applied Nutrition. These officials generally agreed with the factual accuracy of the report and made suggestions for technical revisions, which we incorporated as appropriate.

We also discussed the report with Justice's Assistant Director, Office of Consumer Litigation, who said the report presents a balanced picture of the economic adulteration of fruit juice in this country and accurately reflects Justice's successful prosecution of cases in this area. He also made suggestions for technical revisions, which we incorporated as appropriate.

⁵Laboratory officials who test juice believe that schools would need to test each type of juice from each vendor about once a quarter. Total testing costs were based upon the average cost of about \$500 for a series of juice authenticity tests currently offered by two laboratories in the United States. Testing costs would be reduced if only a few tests, rather than a complete series, were conducted.

We conducted our work from March through October 1995 in accordance with generally accepted government auditing standards. Details on our objectives, scope, and methodology appear in appendix IV.

We are providing copies of this report to the appropriate congressional committees, interested Members of Congress, the Secretaries of Agriculture and Health and Human Services, the Attorney General, and other interested parties. We will also make copies available to others on request. If you have any questions, please contact me at (202) 512-5138. Major contributors to this report are listed in appendix V.

A handwritten signature in black ink, reading "John W. Harman". The signature is written in a cursive style with a large initial "J" and "H".

John W. Harman
Director, Food and
Agriculture Issues

List of Recipients

The Honorable Richard G. Lugar
Chairman

The Honorable Patrick J. Leahy
Ranking Minority Member
Committee on Agriculture, Nutrition,
and Forestry
United States Senate

The Honorable Pat Roberts
Chairman

The Honorable E (Kika) de la Garza
Ranking Minority Member
Committee on Agriculture
House of Representatives

The Honorable William F. Goodling
Chairman

The Honorable William Clay
Ranking Minority Member
Committee on Economic and
Educational Opportunities
House of Representatives

Contents

Letter	1
Appendix I Agricultural Marketing Service's Inspection Services and Costs	16
Appendix II Tests for Detecting Fruit Juice Adulteration and Their Costs	17
Appendix III Estimates on the Extent of Orange Juice Adulteration	18
Appendix IV Objectives, Scope, and Methodology	19
Appendix V Major Contributors to This Report	21
Tables	
Table 1: Summary of Federal Convictions for Adulterating Fruit Juice	8
Table I.1: AMS' Inspection Services and Costs	16
Table II.1: Tests for Detecting Fruit Juice Adulteration and Costs	17
Table III.1: Estimates on the Extent of Orange Juice Adulteration	18

Contents

Abbreviations

AMS	Agricultural Marketing Service
FDA	Food and Drug Administration
FDOC	Florida Department of Citrus
USDA	U.S. Department of Agriculture

Agricultural Marketing Service's Inspection Services and Costs

The U.S. Department of Agriculture's (USDA) Agricultural Marketing Service (AMS) offers food producers three types of inspection services, as table I.1 shows. USDA requires that fruit juice processors agree to being inspected by AMS if they want to participate in USDA's commodity distribution programs. Otherwise, inspections are optional for juice processors.

Table I.1: AMS' Inspection Services and Costs

Type of inspection	Items inspected	Cost	Number of juice plants inspected (FY 1995)
In-plant continuous	All products processed in the plant and the plant itself	\$34 per hour for year-round service and \$39.50 per hour for less than year-round service	44
In-plant designated lot	Only those products sold to the government and the plant itself	\$34 per hour for year-round and \$39.50 per hour for less than year-round service Additional charges for travel expenses at \$39.50 per hour for service that requires less than 4 weeks or 40 hours per week	48
Lot	Only those products sold to the government (the plant itself is not inspected)	\$39.50 per hour Additional charges for travel expenses at \$39.50 per hour	38

Source: AMS.

Tests for Detecting Fruit Juice Adulteration and Their Costs

Several tests are available for detecting the various types of adulterants in fruit juice. The costs of these tests range from \$15 to \$700. However, the tests generally cannot detect adulteration levels below 10 percent, as table II.1 shows.

Table II.1: Tests for Detecting Fruit Juice Adulteration and Costs

Type of adulteration	Name of test	Cost per test	Minimum effective detection level
Dilution with water	Brix	\$15	Not applicable ^a
Dilution with other fruit juices	Polyphenolic	80	10%-15%
Dilution with sugars	Sugar profiling	65	20%-25%
Dilution with sugars	Oligosaccharide	150-190	10%
Dilution with cane or corn sugars	Carbon isotope	50	10%-20%
Dilution with beet sugar	Nuclear magnetic resonance	450-700	10%-20%

^aMinimum detection thresholds have not been established. The Brix test accurately determines the ratio of solids to water in fruit juice. The observed ratio is then compared with predetermined standards. For example, the Brix standard for 100-percent-pure orange juice is 11.8. However, this test cannot determine whether the solids come from 100-percent-pure juice.

Source: Food and Drug Administration, Florida Department of Citrus, and numerous experts from private laboratories, and academia.

Estimates on the Extent of Orange Juice Adulteration

Comprehensive or statistically valid data are not available on the extent to which orange juice is adulterated, but government and private laboratory officials' estimates ranged from 1 to 20 percent. The lower estimates were for orange juice sold to retail customers, and the higher estimates were for orange juice sold to institutions, as table III.1 shows.

Table III.1: Estimates on the Extent of Orange Juice Adulteration

Customer	Source of estimate	Extent of adulteration	Basis for estimate	Limitations
Retail	Florida Department of Citrus (FDOC)	1%	2,503 samples analyzed from 1992 through 1995	Samples mainly from companies participating in FDOC's trademark program
Institutions only	FDOC	18%	120 samples analyzed from 1992 through early 1995	Samples mainly from companies participating in FDOC's trademark program
Retail and institutions	Agricultural Marketing Service (AMS)	1%	1,299 samples analyzed from 1991 through 1994	Only samples of orange juice concentrate coming into Florida
Retail and institutions	Food and Drug Administration (FDA)	16%	74 samples analyzed in 1994	Samples not randomly selected; includes samples from juice plants suspected of adulteration
Retail only	Private laboratory A	3%	Testimonial evidence based on laboratory experience.	Generally, samples suspected of adulteration
Retail only	Private laboratory B	5%	Testimonial evidence based on laboratory experience.	Generally, samples suspected of adulteration
Retail only	Private laboratory C	10%	Testimonial evidence based on laboratory experience.	Generally, samples suspected of adulteration
Institutions only	Private laboratory A	10%	Testimonial evidence based on laboratory experience.	Generally, samples suspected of adulteration
Institutions only	Private laboratory B	20%	Testimonial evidence based on laboratory experience.	Generally, samples suspected of adulteration
Institutions only	Private laboratory C	20%	Testimonial evidence based on laboratory experience.	Generally, samples suspected of adulteration

Source: Officials from AMS, FDA, FDOC, and private laboratories.

Objectives, Scope, and Methodology

The Congress mandated in the Healthy Meals for Healthy Americans Act of 1994 that we review the costs and problems associated with the sale of adulterated fruit juice to the school meal programs. Subsequent discussions with your offices refined the scope of the mandate into the following questions: (1) What are the nature and extent of the juice adulteration problem in the federal school meal programs, and can current inspection and testing methods detect adulteration? (2) What recent federal enforcement actions have been taken against juice adulterators, and what was the magnitude of the fraud? (3) What are the options for enhancing the detection of juice adulteration, including mandatory inspection of juice plants that sell their products to the federal school meal programs?

To determine the nature and extent of the adulteration problem and the ability of current inspection and testing methods to detect adulteration, we contacted officials from the Food and Drug Administration's (FDA) Center for Food Safety and Applied Nutrition and Office of Regulatory Affairs, the U.S. Department of Agriculture's (USDA) Food and Consumer Service and Agricultural Marketing Service, and the Florida Department of Citrus, as well as academic experts and officials from private laboratories involved in testing juice for adulteration. We also contacted various industry associations, including the National Food Processors' Association, the Technical Committee for Juice and Juice Products (an independent organization), and the Apple Processors' Association. We contacted 18 school districts in the 6 states that receive the most federal funding for school meals (California, Florida, Illinois, New York, Pennsylvania, and Texas). We reviewed FDA's and USDA's regulatory standards for fruit juice and USDA's school meal requirements for fruit juice. We also reviewed relevant reports, technical publications on fruit juice testing, and data from FDA and USDA on fruit juice inspections.

To determine recent federal enforcement actions taken against companies for adulterating fruit juice, we discussed prosecutions and the debarment of juice adulterators with officials from FDA, USDA, and the Department of Justice. In addition, we reviewed available literature on court cases and case files maintained by the Department of Justice.

To determine the various options for detecting adulterated juice, we solicited the opinions of government and industry experts. We discussed these options with officials from FDA, USDA, the Florida Department of Citrus, state education offices, and school districts, and with industry

Appendix IV
Objectives, Scope, and Methodology

experts, such as members of the Technical Committee for Juice and Juice Products. We did not fully analyze the cost implications of these options.

Major Contributors to This Report

San Francisco Field Office

Keith Oleson, Assistant Director
David Moreno, Project Leader
Wayne Marsh, Staff Member
Jon Silverman, Staff Member
Kathy Stone, Staff Member

Ordering Information

The first copy of each GAO report and testimony is free. Additional copies are \$2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

Orders by mail:

U.S. General Accounting Office
P.O. Box 6015
Gaithersburg, MD 20884-6015

or visit:

Room 1100
700 4th St. NW (corner of 4th and G Sts. NW)
U.S. General Accounting Office
Washington, DC

Orders may also be placed by calling (202) 512-6000 or by using fax number (301) 258-4066, or TDD (301) 413-0006.

Each day, GAO issues a list of newly available reports and testimony. To receive facsimile copies of the daily list or any list from the past 30 days, please call (202) 512-6000 using a touchtone phone. A recorded menu will provide information on how to obtain these lists.

For information on how to access GAO reports on the INTERNET, send an e-mail message with "info" in the body to:

info@www.gao.gov

**United States
General Accounting Office
Washington, D.C. 20548-0001**

**Bulk Rate
Postage & Fees Paid
GAO
Permit No. G100**

**Official Business
Penalty for Private Use \$300**

Address Correction Requested

