Production Costs and Consumer Acceptance of Dried-on-the-Vine Raisins

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PRODUCTION COSTS AND CONSUMER ACCEPTANCE OF DRIED-ON-THE-VINE RAISINS. By Robert V. Enochian, Mary D. Zehner, Stanley S. Johnson, and Vincent E. Petrucci. National Economic Analysis Division, U.S. Department of Agriculture. Agricultural Economic Report No. 337.

ABSTRACT

It would have been costlier in 1974 to produce California raisins by the experimental dried-on-the-vine (DOV) method than by the predominant natural method, but somewhat cheaper for the experimental continuous tray method. Future increases in labor costs or decreases in costs of required chemicals, however, could bring DOV production into a competitive range. If so, adoption would be gradual, because growers would have to accept new concepts of grape culture, and some would have to make substantial investments. But slow adoption would ease transition for workers displaced during the 30 day grape harvesting season.

Panelists on a Michigan consumer survey in 1974 generally liked and accepted DOV raisins. Response from several exporters, foreign buyers, and food processors was inconclusive.

KEYWORDS: California, consumer acceptance, cost of production, dried-on-the-vine, raisins.

On the Cover: Tractor with attached canopy sprayer spraying grape vines with methyl oleate solution. Canopy sprayer was developed recently by California State University, Fresno, for producing raisins by the DOV method.

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PREFACE

ERS cooperates with other agencies in USDA and the State University system to provide economic knowledge for improving the production, processing, and marketing of farm products. This study is based on a cooperative research project between the ERS and the WRRC, CSU at Fresno, and Michigan State University to develop and evaluate new, more efficient methods of producing raisins.

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SUMMARY

Raisins traditionally have been produced by hand picking ripe grapes and naturally drying them in the sun. Because of the large amount of costly hand labor required in raisin production, new methods are being sought to improve efficiency.

This study compares costs of four different methods of producing raisins and reports consumer acceptance of one method, dried-on-the-vine (DOV) raisins, measured by taste panels and home placement tests. Other methods costed were natural, dehydration, and continuous tray.

The DOV method of drying grapes on the vine followed by mechanical harvesting was originally developed in Australia and recently improved and adapted to California conditions by California State University (CSU), Fresno, in cooperation with the Western Regional Research Center (WRRC) of USDA's Agricultural Research Service. Raisins produced by this method are somewhat different in color, texture, and flavor than raisins produced by the natural method.

The natural method of producing raisins probably will continue to be the favored method in California in the immediate future. However, costlier farm labor, lowered cost of the spray materials used in the DOV process for producing DOV raisins, plus enforcement of more stringent sanitary standards in the production of raisins eventually could result in a shift to the DOV or other methods of producing raisins. A shift from the natural method to the DOV or continuous tray method would require acceptance of some changes in cultural practices by farmers, and possible investments in retrellising and new spray and harvesting machines. Because of these considerations, any shift is likely to be gradual. Since the DOV and continuous tray methods require much less labor input than the natural method, a gradual shift would allow an easier transition of displaced farm workers to other industries.

If a shift takes place, the results of this study indicate that DOV raisins will likely find a favorable response in the domestic household market as an acceptable alternate to natural raisins. Responses of acceptance received from buyers in the domestic food processing and foreign markets were generally favorable but were not adequate to formulate any definite conclusions about the potential for DOV raisins in these markets.

Since DOV raisins were rated higher after home placement testing than at the taste panel sessions, special efforts probably would have to be made in their marketing to explain the special features of these raisins. It would also be important to determine why the younger homemakers found the DOV raisins less appealing than did those over 60.

Consumers as well as foreign buyers objected to the variability in color of DOV raisins. It might prove desirable to sort out the darker colored raisins before packaging them for the retail market. Higher costs, however, might make this practice prohibitive.

The patterns of use for raisins reported by the panelists revealed that those with children at home were most likely to use raisins out of the box as a snack food or in cereals. Those with children under 12, and those under 30, reported that they were less likely to use raisins in salads or in cooked or baked products. These findings point to the need by raisin producers to continually acquaint homemakers, particularly new ones, with the ways in which raisins can be used, especially in cooked or baked products.

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by Robert V. Enochian, Mary D. Zehner, Stanley S. Johnson, and Vincent E. Petrucci

INTRODUCTION

Raisins have been produced and used in the Middle East since Biblical times. From the Middle East, raisin production spread to other parts of the world and now is located mostly in the United States, Australia, Greece, Turkey, Iran, South Africa, Afghanistan, and Spain.

Raisins were first produced in California's central San Joaquin Valley in 1873. U.S. raisin production is now concentrated within a 75-mile radius of the City of Fresno. Production of this area was 235,000 tons in 1974 and each year represents from 25 to 40 percent of the world production. Utilization of the California crop is nearly equally divided among three different market segments: Export, domestic household, and domestic industrial or food remanufacturing.

Since early times, the traditional way of producing raisins has been to hand harvest ripe grapes and to spread them on trays in the sun to dry. As other countries introduced raisin production, some modifications were made to adapt production to local conditions or to produce small quantities of specialty raisins. However, hand harvesting and sun drying has remained the most important method.

Because of the large amount of hand labor required for raisin production, methods of improving efficiency are being sought by a joint project of the Western Regional Research Center (WRRC) of USDA, Albany, Calif., and California State University (CSU), Fresno, as well as by the University of California (UC) at Davis and some private firms.

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This report presents an evaluation of the dried-on-the-vine (DOV) method, which is still undergoing trial, in comparison with other methods to determine its potential for commercialization. Evaluation is based on cost comparisons using present prices for labor and other inputs, and on the results of consumer tests of acceptance of DOV raisins.

METHODS OF PRODUCING RAISINS

Costs of four basic methods of producing raisins are compared in this study. These methods are: (1) Hand picking of grapes followed by sun drying, referred to as the natural method, (2) hand picking of grapes followed by hot air dehydration at a central location, referred to as the dehydration method; (3) mechanical harvesting of grapes followed by sun drying on a continuous paper tray, referred to as the continuous tray method; and (4) drying of grapes on the vine, followed by mechanical harvesting of the raisins, referred to as the DOV method. The first two are presently in regular commercial use while the last two are still in trial use. The procedure for each of these methods is described in the following sections.

Natural Method

This method involves considerable hand labor. When harvest time nears, the rows between the grape vines are smoothed and terraced with a slight pitch toward the sun. After the grapes reach a sugar content of 20 to 23 percent, harvest begins. Grapes are cut by hand in whole bunches into metal pans, and then transferred to 2- by 3-foot paper "trays" on the terraced row. After 10 to 14 days, the grape-laden trays are "turned" by hand to facilitate uniform drying. When the grapes dry to a moisture content of about 16 to 17 percent--6 to 10 days after turning--the trays containing the dried fruit (raisins) are hand rolled into "biscuit" or "cigarette" type rolls, and the raisins are allowed to dry further. When the moisture content of the raisins is 14 to 16 percent, the rolls are picked up and the raisins dumped into "sweat" boxes. After allowing the raisins to achieve a uniform level of moisture (sweat), they are transported from the farm to the processing plant for cleaning, grading, and packaging. Because of the long drying time in the field, this method involves considerable quality loss risk to the grower due to possible rain damage and physical loss due to insects, rodents, and birds. There is also a continual demand from buyers for cleaner raisins than can be produced by open air drying. The other methods of producing raisins reduce these drawbacks to varying degrees.

Dehydration Method

Although the natural method is by far the most prevalent method of making raisins in California, small quantities of raisins are produced commercially by dehydration in counterflow air tunnels heated by gas. With this method, hand harvested fresh grapes are loaded into bins and delivered to a central dehydration plant. The standard procedure is to spray-wash the bunches of grapes and then to pass them through a 0.25 percent hot caustic soda solution.

This treatment results in fine cracks on the surface of each grape and facilitates dehydration. The "soda dipped" grapes are then placed on wood trays which are stacked on dollies and rolled into the dehydration tunnel. After dehydration, the raisins are handled in a similar manner to natural raisins.

One variation of this method includes exposing the soda dipped grapes to fumes of burning sulfur prior to dehydration. This results in what is referred to as "golden bleached" raisins. Also, recently it has been found that by reducing the concentration of the caustic solution and heating the solution to higher temperatures, satisfactory drying results can be obtained. Furthermore, with water near the boiling point, reportedly no caustic whatsoever is required.

Continuous Tray Method[2/]

With this method, 4 to 6 days prior to harvest, the canes of the grapevines are cut, but allowed to remain on the wire trellises. This results in sufficient drying of the stems of the grapes to allow them to be easily dislodged by a mechanical harvester with minimum damage to the fruit. The grapes are then mechanically harvested and directed into a device which deposits the individual grapes onto a continuous paper tray automatically laid behind the harvester. In about 10 to 12 days, when the grapes have dried to a moisture content of 16 percent or less, they are picked up and put into "sweat" boxes for later delivery to the packing house. A machine for picking up the raisins from the trays has also been developed.[3/] Raisins produced by this method are very similar in all respects to raisins produced by the natural method.[4/]

The continuous tray method has been tested each year since 1968. In 1973, USDA and CSU-Fresno conducted a joint research study to evaluate its commercial feasibility.[5/] In 1974, the method was used commercially on 30 acres of grapes, and 30 to 50 acres were planned for commercial application in 1975.

2/ For a complete description of this method, see Studer, H. E., and H. P. Olmo, "The Severed Cane Technique and Its Application to Mechanical Harvesting of Raisin Grapes," Transactions of American Society of Agricultural Engineers, Vol. 14, 1:38-43, 1971.

3/ Studer, H. E., and H. P. Olmo, "Raisin Pickup from a Continuous Paper Tray," Transactions, ASAE, Vol. 17, 1:20-23, 1974.

4/ Studer, H. E., and H. P. Olmo, "Parameters Affecting the Quality of Machine Harvested Raisins," Transactions, ASAE, Vol. 17, 4:783-786, 794, 1974.

5/ White, Elizabeth D. and Vincent E. Petrucci, "Consumer Evaluation of Mechanically Harvested Sun-Dried Raisins," The Marketing and Transportation Situation, Econ. Res. Serv., U.S. Dept. Agr., Feb. 1974.

Dried-On-The-Vine Method

The DOV method was first reported by Australian workers in 1967 and 1969.[6/][7/] In 1968, workers at CSU-Fresno began to experiment with DOV raisins. Since that time, special adaptations have been made in the original process.[8/]

With the DOV method, grapes are allowed to dry on the vines after which they are harvested mechanically, placed in "sweat" boxes for a time, and then taken to the packing house for processing. As with the continuous tray method described above, the fruitbearing canes are cut to initiate drying. This operation alone, however, will not result in rapid enough drying of grapes on the vine. A technique which involves spraying the grapes with a solution that accelerates drying has been developed for achieving this objective.[9/]

Within 3 days after the canes are cut, the grapes are sprayed with a solution containing 2 percent (by volume) of either methyl or ethyl oleate[10/] and 2 percent (by weight) of potassium carbonate applied at the rate of 600 gallons per acre. About 5 to 7 days after the first spraying, a second application of spray of one-half the concentration of the first spraying is made at the rate of 600 gallons per acre. The purpose of the second spraying is to penetrate further into the grape bunches after the first spraying has initiated the drying of the outer grapes. About 10 days after the second spraying (15 to 18 days after cane cutting) most of the fruit has dried sufficiently (14 to 16 percent moisture) to be ready for harvest. At this time, up to 10 percent of the fruit is still not completely dry but in the CSU experiment was dry enough to be harvested along with the dried fruit and equalized in moisture during the "sweating" step.

The spray concentrations used are based on requirements for vigorous vineyards producing 2-1/4 tons of raisins per acre. Experiments carried out by CSU indicate that less vigorous vineyards--those producing 1-1/2 to 1-3/4 tons of raisins per acre--would require somewhat lower concentrations of the oleate spray, thus resulting in somewhat lower costs per acre than indicated below. With lower yields, however, costs per ton of raisins probably would be comparable or even higher.

6/ May, Peter and G. H. Kerridge, "Harvest Pruning of Sultana Vines," VITAS, 6:390-393, Australia 1967.

7/ May, Peter and P. B. Scholefield, "Drying Sultanas on the Vine," Report, Division of Horticultural Research, CSIRO, pp. 41-42, Adelaide, Australia, 1969-1971.

8/ Petrucci, Vincent and Norman Engleman, Unpub.

9/ Vincent Petrucci, Nick Canata, H. R. Bolin, G. Fuller, and A. E. Stafford, "Use of Oleic Acid Derivatives to Accelerate Drying of Thompson Seedless Grapes," Journal of the American Oil Chemists' Society, Vol. 51, 3:77-80, 1974.

10/ Methyl oleate performs the same function as ethyl oleate and is lower in price. At the time this study was made, however, it was not on the FDA list of approved food additives so ethyl oleate was used. Recently, FDA approved methyl oleate as a food additive.

Raisins produced by the DOV method are mostly greenish amber in color. Grapes not covered by the spray solution lose moisture slowly and, if exposed to direct sunlight while drying, are similar to the blue-black color of natural raisins.[11/] DOV raisins also absorb moisture faster, are softer in texture, and reportedly sweeter than natural raisins.[12/]

COMPARISON OF PRODUCTION METHODS

An analysis of costs of producing raisins by the four methods indicates that with 1974 prices for inputs and given the assumptions used, the continuous tray method is the least costly (table 1). This corresponds to the results of a study made in 1973 which also found that raisins produced by the continuous tray method were indistinguishable to consumers from raisins produced by the natural method.[13/]

Since the continuous tray method is only in trial use at this time, while the most costly method, dehydration, is used commercially and the costlier natural method is by far the most important, it is apparent that cost alone does not determine whether one method will be used to the exclusion of all others. Raisins made by the dehydration method have a limited special market and, irrespective of cost differences, other methods now being evaluated might also be used for producing limited quantities of raisins. To capture a large share of the market, however, raisins produced by other methods must be competitive in price with those produced by the natural method as well as being acceptable to buyers and consumers.

With 1974 prices and the assumptions used, the DOV method was only slightly higher in cost than the natural method. Costs for the mechanical harvesting operations for both the DOV and the continuous tray methods are, however, tentative because of the limited experience with these methods. As indicated in footnote 6 of table 1, these costs are based on the costs of harvesting wine grapes developed by the University of California Extension Service, and are further adjusted for a somewhat faster mechanical harvester travel speed with these two methods. Farmers who have used these methods state that since the estimates of travel speed used for the mechanical harvester might be somewhat on the conservative side, the cost estimates of both the DOV and continuous tray methods given in table 1 may be somewhat overstated.

11/ Studer, H. E. and H. P. Olmo, "Vine Drying of Thompson Seedless Grapes," Transactions, ASAE, Vol. 16, 5:947-948, 952, 1973.

12/ H. R. Bolin, Vincent Petrucci, and G. Fuller, "Characteristics of Mechanically Harvested Raisins Produced by Dehydration and Field Drying," Journal of Food Science, Vol. 40, 5:1036-1038, 1975.

13/ White, Elizabeth D., op. cit.

Table 1--Estimated costs of harvesting and drying raisins by four methods, Fresno, Calif., 1974

Operation	Method			
	Natural[1/]	Dehydration	Continuous tray	DOV
	Dollars per acre[2/]			
Prepare ground[3/]	8.17	-	8.17	-
Cut canes[4/]	-	-	13.62	13.62
Spray vines[5/]				
Rig and operator	-	-	-	8.17
Spray materials	-	-	-	126.00
Harvest				
Machine[6/]	-	-	104.00	86.66
Hand labor[7/]	114.72	114.72	-	-
Materials[8/]	12.87	-	25.50	-
Post-harvest operations				
Turn and roll trays[9/]	32.63	-	-	-
Pick up and box raisins[10/]	26.66	-	17.60	-
Delivery to processing plant[11/]	11.25	50.00	11.25	11.25
Rain damage insurance[12/]	16.88	-	16.88	-
Dehydration[13/]	-	337.50	-	-
Miscellaneous[14/]	22.50	-	22.50	22.50
Total cost per acre	245.68	502.22	219.52	268.20
Cost per ton	109.19	223.21	97.56	119.20

1/ Cost estimates for the natural method are based largely on data from 1974 Grape Production Costs in the San Joaquin Valley, Thompson Seedless for Raisins or Wine, Univ. Calif. Coop. Ext. Serv., AXT-56, rev. June 1974.

2/ Based on 10 tons fresh grapes or 2-1/4 rons raisins per acre.

3/ Includes discing and terracing for the natural and continuous tray methods, each of which requires 3/4-hour labor plus 3/4-tractor hour per acre. Subsequently, the terraces would have to be disced down, but discing would be required with the other methods prior to irrigation; therefore, the cost of this operation is omitted from all four methods.

4/ Based on piece rate of 3.0 cents per vine x 454 vines per acre.

5/ Requires two sprayings. Each spraying requires spray rig and operator for 3/4-hour per acre. Materials for first spraying: 2 percent ethyl oleate (12 gallons in 600 gallons of water) plus 2 percent by weight of potassium carbonate (96 pounds). Materials for second spraying: 1 percent ethyl oleate (6 gallons in 600 gallons of water) plus 1 percent potassium carbonate

Footnotes continued

(48 pounds). During the 1974 season, the price of ethyl oleate to the farmer was $5.75 per gallon and potassium carbonate was $0.25 per pound. However, since this study was made, methyl oleate, which is lower in cost and performs the same function, has been approved for food use by the Food and Drug Administration. For purposes of this study, therefore, the 1974 price of $5.00 per gallon for methyl oleate was used.

6/ Custom charge in 1974 for mechanical harvesting of fresh grapes for the winery was $18 per ton including hauling. Assuming $5 per ton for hauling (see footnote 11) and 10 tons yield per acre, this is equivalent to $130 per acre for mechanical harvesting of fresh grapes. With the continuous tray method, a device for laying the paper trays and spreading grapes on the trays is required which offsets the costs of gondolas and tractors required for harvesting fresh grapes. The equipment component for harvesting DOV raisins is nearly the same as for fresh grapes. It is also assumed that for continuous tray harvest 1-1/4 acres can be harvested per hour and for DOV raisin harvest 1-1/2 acres can be harvested an hour compared with an average of 1 acre per hour for winery fruit.

7/ Based on estimate of 425 trays per dry ton, 2-1/4 dry tons per acre and going rate in 1974 of 12.0 cents per tray. Assumes same picking costs for dehydration as for picking on trays.

8/ Requires 990 paper trays per acre for natural method (including waste and damage) at 1974 price of 1.3 cents per tray. The cost for the continuous paper tray method is estimated in an unpublished manuscript by Henry E. Studer, Univ. Calif. at Davis, Feb. 1, 1974.

9/ Contract charge in 1974 for turning and rolling trays was $14.50 per ton.

10/ Pick up and boxing requires 4 man-hours labor and 1/2 tractor-hour per ton for a total cost of $11.85 per ton of raisins for the natural method. The cost for the continuous paper tray method is estimated in an unpublished manuscript by Henry E. Studer, Univ. Calif., Davis, Feb. 1, 1974.

11/ Based on average cost of $5 per ton of grapes or raisins.

12/ Based on insurance coverage of $250 per ton for raisins. Assumes no insurance required for the DOV method.

13/ Based on a custom charge of all dehydration plant operations of $150 per dry ton of raisins including costs of bins for hauling fruit to the dehydration plant.

14/ Includes an estimated cost of $11.25 for sweat boxes for the natural, continuous tray, and DOV methods plus other miscellaneous costs. These miscellaneous costs are included in the dehydration charge for the dehydration method.

Changes in wage rates and the price of spray materials also will affect the comparative costs of the natural and the DOV methods. Since the natural method is more labor intensive than the DOV method, increases in wage rates will increase the costs of the natural method more than the DOV method. On the other hand, decreases in the prices of the spray materials will result in a lowering of the cost of the DOV method without a corresponding decrease in the cost of the natural method.

Both increases in wage rates and decreases in prices of spray materials are expected to occur in the future. Farm labor unions are achieving greater bargaining strength and thus are expected to be effective in acquiring more rapid gains in wage rates for farmworkers. Furthermore, as shown in table 2, the prices of oleate compounds are dependent upon the prices of soybean oil as well as the quantities produced. Prices for soybean oil as well as oleate compounds made from it have declined since 1974, when the price of soybean oil was especially high.

Table 2--Estimated prices to farmers for ethyl and methyl oleate, Fresno, Calif., relative to assumed prices for soybean oil in Decatur, Ill.

Price per pound of soybean oil	Price of ethyl oleate purchased from plant with -		Price of methyl oleate purchased from plant with -	
	Annual capacity of 3,000-5,000 gallons	Annual capacity of 60,000-100,000 gallons	Annual capacity of 3,000-5,000 gallons	Annual capacity of 60,000-100,000 gallons
Cents	Dollars per gallon			
34	7.00	6.50	6.25	5.75
27	6.25	5.75	5.50	5.00
20	5.50	5.00	4.75	4.25

Experiments were carried out by CSU in the 1975 crop year to test the effectiveness of sodium carbonate as a replacement for potassium carbonate in the spray solution but results are not yet available. The cost of sodium carbonate in 1974 was about 5.0 cents per pound rather than the 25.0 cents for potassium carbonate. If the 1975 experiments show that sodium carbonate can be substituted for potassium carbonate on a pound for pound basis, this will result in another possible reduction in the cost of the DOV method.

Adoption of the DOV method by raisin producers, however, will depend upon a number of factors other than cost savings.

FARMERS' EXPERIENCES WITH THE DOV METHOD

The DOV method as described above has been tried for several seasons on the experimental farms of CSU, Fresno, with good results. During the 1974 season, several farmers in the Fresno area tested the DOV method on small acreages of grapes. The results of these trials indicate that further evaluation will be required to determine appropriate controls for achieving uniformly acceptable results, before the method is recommended for adoption on a large commercial scale.

The major problem encountered by the farmers who used the DOV method in 1974 was uneven drying of the fruit. All of the reasons for this could not be determined with certainty, but several factors may have caused the problem. Up to 10 percent of the fruit remains attached to the vine head, behind the cut canes, or on canes which inadvertently have been left uncut. This fruit loses moisture slowly. Although these grapes would have been harvested by the mechanical harvester, in some cases farmers did not believe they were adequately dry to equilibrate in moisture during the "sweating" step and so they hand picked them for tray drying before mechanically harvesting the DOV raisins. This problem might not arise in another year but a regular procedure may have to be adopted to avoid it. Possible solutions would be to either mechanically pinch the stems of the bunches of grapes in the vine head or to hand pick these bunches and hang them on the wire trellises prior to the spraying operation. Because of the additional labor, this procedure would tend to increase the costs of the DOV method somewhat over the estimates given in table 1, but no data are available to estimate by how much.

Two other possible reasons why the grapes did not dry uniformly during the 1974 farm trials may have been a lack of uniformity in applying the spray to the grapes and possible failure on the part of some farmers to follow prescribed concentrations or rates of application of the spray solution. The lack of uniformity in spray application may have been due to the type of spray rig used or to the unequal or inadequate suspension of the chemicals in the spray solution, or both.

In the 1974 trials, farmers used the same rigs they normally use for pesticide application. These rigs use higher pressures and a different spray pattern than the rig used at the CSU experimental farm, which was especially designed for the new method of drying. The vine leaves may have prevented spray from pesticide rigs from reaching the grape bunches. Trials were conducted by CSU during the 1975 crop year to determine the part each of these factors might have had in causing the lack of uniform drying experienced by farmers in the 1974 trials but results are not yet available.

The lack of uniformity in drying also might have been due to the failure on the part of some farmers to follow instructions in mixing and applying the spray. The concentration of the chemicals in the spray, or the amount of the solution sprayed on the grapes, might have been reduced in an attempt to reduce the cost of the spray materials. If the results of the 1975 trials by CSU show that this was the probable cause for the poor results in the 1974 farm trials, precautions will be taken to inform farmers who plan to adopt the DOV method of the necessity to follow exact instructions to achieve the desired results.

CONSUMER EVALUATION OF RAISINS

As previously indicated, raisins produced by the DOV method are different in color, texture, and flavor than raisins produced by the natural method. To determine whether these raisins would meet with any consumer resistance in the market, they were subjected to an evaluation by a statewide consumer panel in Michigan which is conducted annually by the Michigan Cooperative Extension Service. The panel in which DOV raisins were included was conducted in the spring of 1974 and included a total of 2,227 consumers. The evaluation was done in two parts. A panel was used to measure the taste acceptance of DOV raisins and to determine the usual purchase patterns for raisins by Michigan consumers. Then acceptance of the DOV raisins was evaluated with a home placement test. All panelists did not return usable questionnaires for this part of the evaluation.

Michigan Consumer Panels

A series of consumer panels is conducted once a year in Michigan in an effort to inform the food industry about consumers' opinions and attitudes toward new food products and packaging. Panel sessions are held with groups of 30 to 75 volunteers, at each of 14 locations in Michigan's lower peninsula. Most panelists are women. Panelists evaluate five or six different items and record individual preferences on the forms provided.

Information on income level, size of family, age, and education level of the female head of the household, and stage of the family life cycle, is obtained from participants. In the 1974 panels, about half the panelists were from the Detroit metropolitan area. The composition of the panelists, compared to the total population of Michigan, was weighted toward women with above average education and income. The average size of the panel household was 3.62, compared with the average Michigan household of 3.27 persons. The demographic characteristics of the panels are given in table 3.

Panel Evaluation of DOV Raisins

About half the panelists received only a sample of DOV raisins to evaluate, while the other half received samples of DOV raisins and a "control" sample of raisins from the same vineyard produced by the natural method. Panelists were asked to taste the samples and record their opinions on a 7-point hedonic scale ranging from "like very much" to "dislike very much."

The DOV raisins were very well received by both groups of panelists (table 4). Of those who evaluated only the DOV raisins, nearly three-quarters rated them in the top two categories. Panelists who received the double samples rated the control sample slightly higher than the DOV raisins. When asked how the DOV raisins compared with raisins they were using, 68 percent of the panelists said that they were as good or better and 29 percent said they were not as good. Comments indicate that some of the panelists thought the control raisins had more flavor than the DOV raisins, and that the lighter color of the DOV raisins would make them most useful for cooking and baking.

Table 3--Demographic characteristics of 2,227 participants in 1974 Michigan Consumer Panel

	Percent		Percent
Age of panelist		Family composition	
Under 30 years	15	Adults only	37
30-44 years	37	Adults with children 12 years and under	26
45-59 years	34	Adults with children 13 to 19 years	18
60 years and over	4	Adults with children both 12 years and under and 13 to 19 years	19
Education level of panelist			
Some high school	12		
Completed high school	34	Employment of panelist outside home	
Some college or business school	34		
Completed college	20	Full-time	16
		Part-time	15
Size of household[1/]		Not employed	69
1-2 members	32	1973 total family income	
3-4 members	41		
5 or more members	27	Under $7,000	12
		$7,000-$9,999	9
		$10,000-$14,999	31
		$15,000-$19,999	26
		$20,000 and over	19
		No answer	2

1/ Average size of household was 3.62 members.

Panelists who received only DOV raisins reported slightly greater willingness to buy them than those who received double samples (table 4). This willingness to purchase increased after the home placement test.

Home Placement Test of DOV Raisins

Each panelist received an 8-ounce package of DOV raisins and a questionnaire which they were to complete after serving the test raisins to family members. A total of 1,806 completed questionnaires were returned, an 81-percent response. The home placement test was designed to evaluate the acceptance of the DOV raisins (especially the color and sweetness level), possible willingness to buy, and whether or not the DOV raisins might replace current raisins purchased or be used in addition to other raisins.

Panelists were asked to report the ways in which they used the DOV raisins in the home placement test. The most frequently reported use was as a snack

Table 4--Evaluation of DOV raisins by participants, 1974 Michigan Consumer Panel

Question and response	1,165 panelists receiving only DOV raisins	1,062 panelists receiving 2 samples	
		Control raisins	DOV raisins
	Percent		
How well do you like these raisins?			
Like very much	41	42	41
Like moderately well	32	33	28
Like slightly	10	10	12
Neither like nor dislike	7	5	6
Dislike slightly	5	5	6
Dislike moderately	2	2	4
Dislike very much	2	2	3
No response	1	--	0
How do test raisins compare with ones now using?			
Better than ones now using	31	NA	NA
About the same	37	NA	NA
Not as good	29	NA	NA
No response	3	NA	NA
Which sample do you prefer?			
Dried on-the-vine	NA	41	
Control sample	NA	43	
Like both equally	NA	15	
Don't care for either	NA	1	
Would you be willing to buy DOV raisins if priced the same as other raisins?			
I would definitely buy them	30	34	
I would probably buy them	33	25	
Not sure, I may sometimes	19	22	
I don't think I am interested	12	12	
I am positive I would not	5	6	
No response	1	1	

-- = Less than 1 percent.
NA = Not applicable.

between meals, followed by use in cooked or baked products, in cereals, in salads, and in lunch boxes. Older homemakers reported using the DOV test raisins mostly in a cooked or baked product and in cereals or salads, while younger homemakers reported using them mostly as a snack between meals. Households with children at home and families with an income level of $7,000 and over reported using the DOV test raisins most often as a snack item, while homemakers in households with adults only and income levels under $7,000 reported more frequent use in cooked products or in salads.

More than four-fifths of the homemakers liked the DOV raisins either "very much" or "moderately well" (table 5). Overall, all panelists said they liked DOV raisins "moderately well." It should be pointed out that the older homemakers favored the DOV raisins more than the younger homemakers. The DOV raisins also were rated somewhat higher in households with adults only than those with children.

Overall, those who returned the questionnaires rated the DOV raisins higher after the home test than after the panel session (table 6). This indicates the need for an explanation on the DOV raisin package in promotion of the special features of these raisins.

There was a 13-percent increase in those reporting they would definitely buy DOV raisins after the home placement test compared with the responses at the panel session (table 6). Perhaps consumers' image of raisins is associated with the darker natural raisins and they needed to be assured that the lighter DOV raisins taste good, too.

After generally evaluating the DOV raisins, the homemakers were asked to rate specific characteristics which might influence their acceptability--flavor, color, sweetness, and texture. Most seemed satisfied with DOV raisins as they were. Over 80 percent liked both the flavor and texture, and over 70 percent liked the sweetness and color (table 7).

Reasons given for nonacceptance were that DOV raisins were too sweet and too light in color, did not have enough flavor, and were too soft in texture. Differences in age of the homemakers and stage of the family life cycle were the strongest influences on the rating of the specific characteristics of the DOV raisins. Homemakers over 45 and those households with only adults found the flavor, color, sweetness, and texture more acceptable than did homemakers under 30. Homemakers with children under 12 reported these characteristics as being the least acceptable. It was not learned whether it was the homemakers themselves or their children that disliked them. Sweetness level was most unacceptable to the younger homemakers.

After the DOV raisins had been evaluated at home, homemakers were asked, "Would you buy these test raisins if they were available in the store and priced the same as other raisins?" From a list of five statements, they were asked to check which phrase best represented their opinion. The responses were as follows:

Table 5--Evaluation by 1,789 participants of DOV raisins in home placement test, 1974 Michigan Consumer Panel

Item	Taste acceptance						
	Like very much	Like moderately well	Like slightly	Neither like nor dislike	Dislike slightly	Dislike moderately	Dislike very much
	Percent						
All participants	52	30	7	5	3	2	1
Age of homemaker 1/							
Under 30 years	38	32	10	9	4	5	3
30-44 years	45	34	8	4	4	3	2
45-59 years	57	29	5	5	2	2	--
60 years and over	70	23	3	3	1	--	--
Education level of homemaker							
Some high school	59	28	3	4	2	2	2
Completed high school	47	34	8	4	4	2	1
Some college	55	29	6	4	2	3	1
Completed college	50	20	7	6	4	2	2
Family composition 1/							
Adults	60	27	5	4	2	1	1
Adults and children 12 and under	44	33	8	6	3	4	2
Adults and children 13-19	51	29	7	6	4	2	1
Adults with children both 12 and under and 13-19	48	34	8	4	3	2	1

-- = Less than 1 percent.

1/ Chi-square test significant at 1-percent level.

Table 6--Comparison of evaluations of DOV raisins at panel session and after home placement test, 1974 Michigan Consumer Panel

Item	At panel session	After home placement test
		Percent
Evaluation by 1,784 participants		
Like very much	42	52
Like moderately well	30	30
Like slightly	11	7
Neither like nor dislike	6	5
Dislike slightly	5	3
Dislike moderately	3	2
Dislike very much	3	1
		Score
Mean score 1/	5.79	6.12
		Percent
Would be willing to buy DOV raisins (1,787 respondents)		
Definitely	34	47
Probably	29	28
Not sure	20	15
Don't think so	11	7
Positively would not	6	3

1/ Like very much = 7, dislike very much = 1.

Table 7--Rating by 1,773 participants of selected characteristics of DOV raisins, 1974 Michigan Consumer Panel

Characteristic	Response
	Percent
Flavor	
Acceptable	82[1/]
Not acceptable	18
Not acceptable because:	
Not enough flavor	77[1/]
Too much flavor	23
Color	
Acceptable	71[1/]
Not acceptable	29
Not acceptable because:	
Too light a color	95[1/]
Too dark a color	5
Sweetness	
Acceptable	74[1/]
Not acceptable	26
Not acceptable because:	
Too sweet	70[1/]
Not sweet enough	30
Texture	
Acceptable	87[1/]
Not acceptable	13
Not acceptable because:	
Too chewy	38
Too soft	62[1/]

1/ Chi-square test significant at 1-percent level.

	Percent
Yes, I would definitely buy them	47
I would probably buy them	28
Not sure, I may buy them	15
I don't think I'm interested in buying them	7
I'm positive I'd never buy them	3
	100

These responses indicate a favorable market potential. Again, the younger homemakers (under 30) and those with children under 12 were least positive about buying the DOV raisins, while older homemakers (60 and over) were most positive.

An effort was made to determine whether homemakers would use the DOV raisins in addition to raisins now used, or in place of the raisins now used. About two-thirds reported the DOV raisins would represent a substitution for raisins now used while one-fourth indicated they would use them in addition to other raisins.

Use Patterns for Raisins

Panelists were asked to indicate how often they served raisins, the ways in which they usually used or served raisins, and the size of raisin package they usually purchased. The responses may not reflect normal purchase and use patterns because of the short supply and high prices for raisins in 1973 and early 1974.

Nearly half the panelists reported serving or using raisins at least once a month (table 8). These panelists typically had completed college, were full-time homemakers or employed part-time outside the home, had three or more family members, and had children under 12. Panelists with the most education used raisins most frequently. Those panelists employed full-time outside the home and those with small households or no children used raisins once a month or less.

Panelists reported using raisins most often in cooked or baked products, followed by use as a plain snack between meals (table 9). Those most likely to use raisins as a snack were under 45 and had three or more members in the household, had children under 12, had completed high school or some college, and had family incomes of $10,000 and over. Those most likely to use raisins in salads were over 45 and had educations beyond high school, while those most likely to use raisins in cooked or baked products were over 30. Proportionately, the greatest nonusers of raisins were those under 30 and those in small, one-to-two member households.

Close to half the panelists reported that they usually buy the 15-ounce box, followed by the 2-pound bag, individual 1-1/2-ounce boxes, and those buying both the individual boxes and the larger bag or box. Only 6 percent indicated they did not buy raisins.

EVALUATION OF DOV RAISINS BY DOMESTIC FOOD PROCESSORS AND FOREIGN BUYERS

In addition to the consumer evaluation made by use of the Michigan Consumer Panel, attempts were made to evaluate the acceptance of DOV raisins by both foreign buyers and domestic food processors.

We asked three San Francisco exporters of dried fruits to send small samples of DOV raisins and a questionnaire to some of their foreign buyers. Two exporters did so. The third agreed that he and his foreign sales staff would give us their impressions of DOV raisins.

In all, 15 samples and questionnaires were sent to buyers in Japan and in the Scandinavian countries. Only three completed questionnaires were returned, all by Scandinavian buyers. On the basis of this experience, and discussions with the exporters, only very tentative conclusions can be drawn about the acceptance of DOV raisins by foreign buyers.

Table 8--Frequency of serving or using raisins reported by 2,216 participants, 1974 Michigan Consumer Panel

Item	Once a week or more often	1-3 times a month	Less than once a month	Do not use raisins
		Percent		
All participants	21	27	45	7
Size of family[1/]				
1-2	18	26	46	10
3-4	22	27	45	6
5 or more	22	29	44	5
Employment of homemaker				
Full time	15	23	54	8
Part time	22	31	40	7
Not employed	22	28	44	6
Educational level of homemaker				
Some high school	19	21	52	8
Completed high school	18	29	46	7
Some college	22	28	44	6
Completed college	26	28	39	7
Family composition				
Adults	20	26	45	9
Adults and children 12 and under	26	30	39	5
Adults and children 13-19	16	25	52	7
Adults with children both 12 and under and 13-19	21	29	46	4

1/ Chi-square test significant at 1-percent level.

Table 9--Ways of using raisins reported by 2,176 participants in 1974 Michigan Consumer Panel

Item	Raisins are usually served or used--				Do not use raisins
	In cooked or baked products	For snacks between meals	With cereal	In salads	
	Percent				
All participants	81	66	29	28	6
Size of family					
1-2	79	46[1/]	28	31	9[1/]
3-4	81	70[1/]	28	26	5[1/]
5 or more	82	83[1/]	32	27	4[1/]
Age of homemaker					
Under 30 years	69[1/]	70[1/]	31	19[1/]	10[1/]
30-44 years	81[1/]	80[1/]	31	25[1/]	4[1/]
45-59 years	84[1/]	61[1/]	27	32[1/]	6[1/]
60 years and over	86[1/]	37[1/]	26[1/]	35[1/]	6[1/]
Educational level of homemaker					
Some high school	82	51[1/]	27	23[1/]	8
Completed high school	80	68[1/]	27	22[1/]	6
Some college	81	71[1/]	30	30[1/]	5
Completed college	81	63[1/]	33	36[1/]	6
Income level					
Under $7,000	82	47[1/]	32	29	7
$7,000-$9,999	79	64[1/]	31	31	4
$10,000-$14,999	81	67[1/]	27	25	6
$15,000 and over	81	72[1/]	31	29	5
Family composition					
Adults	80[1/]	48[1/]	28[2/]	31[1/]	9[1/]
Adults and children 12 and under	76[1/]	83[1/]	33[2/]	22[1/]	4[1/]
Adults and children 13-19	86[1/]	61[1/]	24[2/]	29[1/]	6[1/]
Adults with children both 12 and under and 13-19	84[1/]	82[1/]	32[2/]	28[1/]	3[1/]

1/ Chi-square test significant at 1-percent level.
2/ Chi-square test significant at 5-percent level.

First, the high incidence of nonresponse to the questionnaires indicated less than a high level of interest in the DOV raisins by buyers in Japan and the Scandinavian countries. Second, even the Scandinavian buyers who returned the questionnaires gave ghe impression of being, at best, indifferent as to a choice between natural and DOV raisins and found the variability in color objectionable. One buyer indicated that he would be interested in the DOV raisins only if they were lower in price and were more humidity-stable than natural raisins. Finally, our discussions with the exporters indicated that although they believed foreign buyers would accept the DOV raisins, if that is what they were offered, they did not believe there was any reason for them to prefer DOV raisins unless they were available at a lower price than natural raisins. Also, since DOV raisins are light in color, the exporters thought that they would have to compete with Australian raisins, which generally sell at a lower price than California natural raisins.

Acceptance of DOV raisins by domestic food processors would seem to be only slightly better than by foreign buyers. This conclusion is based on responses received by two of the major raisin packers in the Fresno area who sent samples of the DOV raisins to some of their industrial buyers for evaluation. The impression gained from these responses, which were given to the packers by letter or by telephone, was that DOV raisins generally would be acceptable as a replacement for natural raisins in food products and that in most uses, since they seem to offer no apparent definable advantages over natural raisins, they probably would have to be offered at a lower price.

PROBABILITY OF A SHIFT TO NEW METHODS

It is apparent that the costs of producing raisins by the dehydration method are so high relative to the other three methods that in the foreseeable future only relatively small quantities will be produced as a specialty raisin. Furthermore, in view of the current shortages and escalating prices of natural gas, use of the dehydration method for producing even small quantities of raisins would appear to be threatened. Therefore, the probable impacts of a shift in the use of this method is not considered in this analysis.

The costs of the other three methods are so close that relatively minor changes in the prices of one or more input could change the relative total costs among the methods. This could result in a shift away from the natural method, which is the predominant method at present, to the DOV or continuous tray methods, which are much less labor intensive. The estimated impact of such shifts on farm labor and energy use might be of interest to those who are concerned with the welfare of farmworkers and the conservation of energy resources.

No attempt was made to develop complete labor and energy requirements for each method. Only those operations not common to each of the methods were compared. The labor and equipment requirements, in hours per acre, for the natural, the DOV and continuous tray methods are given in table 10. Even though the natural method is by far the most labor intensive, its use of equipment does not seem to be significantly less than the DOV and the continuous tray methods. Because of the different rates of use of fuel by tractors and mechanical harvesters, however, the additional costs of fuel usage with both

Table 10--Labor and equipment time requirements per acre for three different methods of producing raisins, Fresno, Calif., 1974 season

Operation	Natural		Continuous tray		Dried on the vine	
	Labor	Equipment	Labor	Equipment	Labor	Equipment
	Hours					
Prepare ground[1/]	1.5	1.5	1.5	1.5	--	--
Cut canes[2/]	--	--	6.0	--	6.0	--
Spray vines[3/]	--	--	--	--	1.5	1.5
Harvest[4/]	45.0	.5	3.2	2.4	2.7	2.0
Turn and roll trays[5/]	11.5	--	--	--	--	--
Pick up and box raisins[6/]	9.0	1.2	1.0	1.0	--	--
Total	67.0	3.2	11.7	4.9	10.2	3.5

1/ Includes discing and terracing, each of which requires 3/4-hour labor and 3/4-tractor-hour per acre.

2/ Estimated by farmers who used these methods in 1974.

3/ Two sprayings each requiring 3/4-hour for spray rig and operator.

4/ Labor for the natural method based on estimate by Fresno farm labor office; equipment time estimated for distributing paper trays, etc. Labor for continuous tray method based on harvester operator, 2 tractor operators, and a "floater" for harvest rate of 1-1/4 acres per hour; equipment required is 1 harvester and 2 tractors at the same rate. Labor for DOV method based on harvester operator, 2 tractor operators, and a "floater" for harvest rate of 1-1/2 acres per hour; equipment required is 1 harvester and 2 tractors at the same rate.

5/ Based on estimates by Fresno farm labor office.

6/ Labor and equipment requirements for natural method based on data from 1974 Grape Production Costs in the San Joaquin Valley, Thompson Seedless for Raisins or Wine, Univ. Calif. Coop. Ext. Serv., AXT 56, rev. June 1974. Estimates for the continuous paper tray method based on unpublished manuscript by Henry E. Studer, Univ. Calif. Davis, Feb. 1, 1974.

the DOV and the continuous tray methods would be fairly substantial over an entire season if all raisin acreage were converted to one of these methods. Table 11 gives equipment requirements, fuel usage, and fuel costs per acre for the natural, the DOV, and the continuous tray methods. For the 1974 season, the cost of diesel fuel per acre was $1.92 for the natural method, $2.30 for the DOV method, and $3.18 for the continuous tray method.

As was indicated in the introduction, about 235,000 tons of raisins were produced in 1974, virtually all by the natural method. At an average yield of about 2 tons of raisins per acre, this represents the production from about 117,500 acres.

If this entire acreage had been produced by the DOV method in 1974, the additional fuel requirement would have been 152,750 gallons at a cost of $45,825. If it had been produced by the continuous tray method, the additional fuel requirement would have amounted to 493,500 gallons at a cost of $148,500.

As costs of labor rise and if the costs of the spray materials required for producing DOV raisins are reduced, the DOV method may have a comparative economic advantage over the other methods. However, on the basis of the results of the cost analysis alone, it would seem doubtful that a rapid shift to the DOV or the continuous tray method is likely to take place. The natural method and its end product are well established with farmers, the packers, marketing agencies, and consumers.

Finally, the current raisin harvest provides seasonal employment for a large number of workers. Shifting to the DOV or continuous tray methods would reduce the number of jobs. Using the labor requirements per acre in table 10, the total annual labor required for 117,500 acres with the natural method would amount to about 7.87 million man-hours. Since the requirement for this labor occurs within about a 30-day period, and assuming an 8-hour workday, a period of 240 hours is available during the season in which to accomplish the entire raisin production and harvesting operation. This means that approximately 32,800 employees are gainfully employed during the approximately 30 days of the raisin harvest.

Barriers to Adoption

Even with a comparative economic advantage, there are barriers that would preclude a rapid large-scale shift to either the continuous tray or the DOV method. Several years would be needed to build the mechanical harvester capacity for using either of these methods on a large scale. Lighter colored, softer DOV raisins would find general acceptance in the domestic household market only gradually as they are promoted and as consumers become familiar with their attributes. In overseas markets, the DOV raisin would have to compete against the lighter Australian raisins, which generally sell for less than California natural raisins. Some raisin producers and packers believe that large-scale production of a lighter colored raisin by California growers would reduce the competitive advantage that California's darker colored raisins now have in most world markets. Others have reported, however, that in some markets, notably West Germany, there is a definite preference for light colored raisins.

Table 11--Equipment requirements, fuel usage, and fuel costs per acre for three methods of producing raisins, Fresno, Calif., 1974 season

Operation	Natural			Continuous tray			Dried on the vine		
	Equipment	Fuel usage	Fuel cost	Equipment	Fuel usage	Fuel cost	Equipment	Fuel usage	Fuel cost
	Hours per acre	Gallons per acre	Dollars per acre	Hours per acre	Gallons per acre	Dollars per acre	Hours per acre	Gallons per acre	Dollars per acre
Prepare ground[1/]	1.5	3.0	.90	1.5	3.0	.90	--	--	--
Spray vines[1/]	--	--	--	--	--	--	1.5	3.0	.90
Harvest[2/]	.5	1.0	.30	2.4	5.6	1.68	2.0	4.7	1.41
Pick up and box raisins[1/]	1.2	2.4	.72	1.0	2.0	.60	--	--	--
Total	3.2	6.4	1.92	4.9	10.6	3.18	3.5	7.7	2.31

1/ Equipment used is a 40 h.p. diesel tractor using 2 gallons of diesel fuel per hour at 30 cents per gallon.

2/ Equipment for the natural method is a 40 h.p. diesel tractor. For the continuous tray method, the equipment requirements are 2-40 h.p. diesel tractors, each operating for 0.8 hour per acre, and a mechanical harvester operating for 0.8 hour per acre. For the DOV method, the equipment requirements are 2-40 h.p. diesel tractors, each operating for 0.66 hour per acre, and a mechanical harvester operating for 0.66 hour per acre. The mechanical harvester uses 3.0 gallons of diesel fuel per hour of operation.

Sources: For fuel use of tractors: A. Doyle Reed, Machinery Costs and Performance, AXT-336, Univ. Calif. Agr. Ext. Serv., Davis, rev. April 1975.

For fuel use of mechanical harvesters: Stanley S. Johnson, "An Economic Analysis of Wine Grape Production with Emphasis on Harvesting Mechanically," unpublished manuscript, Econ. Res. Serv., U.S. Dept. Agr.

Many California vineyards, especially those 50 acres or less, are old with stakes and wire trellises that would not support mechanical harvesting. These stakes and trellises would have to be replaced at considerable cost.

Finally, some farmers seem reluctant to adopt the practice of cutting the fruitbearing canes prior to harvest, needed for both the continuous tray and the DOV methods. This reluctance seems to be based on the lack of acceptable evidence as to the long-term effects of early cane cutting on the productivity of the grape vines. Preliminary observations by research workers at the CSU experimental farms indicate no harmful effects from this practice and further observations are being made. Studies made by researchers in Australia over several seasons seem to indicate only a slight decline of productivity from vines that have received the most severe cane-cutting treatments.14/

If a shift to the continuous tray or DOV method takes place, all of these factors would seem to indicate that it will be gradual. A shift of 4 to 5 percent of the total acreage, or about 5,000 acres each year, would seem to be the most rapid rate possible. In that case, about 1,300 to 1,600 fewer farmworkers would be needed each year in the San Joaquin Valley during the approximately 30-day harvest season during September and October. With appropriate planning for alternative employment by local authorities, this adjustment should not present a major problem.

14/ Mechanical Harvesting of Grapes, Report 1971-73, Division of Horticultural Research, Commonwealth Scientific and Industrial Research Organization, Adelaide, Australia, pp. 56-60.