QUALITY of DRIED FRUITS

A SURVEY OF DRIED APRICOTS, PRUNES, RAISINS, AND FIGS IN RETAIL MARKETS

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PREFACE

A survey of the quality of dried fruits in retail markets was undertaken by the Agricultural Marketing Service at the request of the Dried Fruit Industry Research Advisory Committee. It is a part of a national research program to maintain and improve the quality of farm products during marketing.

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SUMMARY

Consumer packages of dried apricots, prunes, figs, and raisins were collected in retail stores and compared with samples that were obtained from packers and held under desirable storage conditions. The comparisons were made to determine the types and extent of deterioration of quality during marketing. Seven percent of the apricot samples obtained in retail stores, 11 percent of the prune samples, 13 percent of the raisin samples, and 17 percent of the fig samples showed that they had reached an undesirable quality level. The most prevalent type of deterioration was darkening of the flesh and loss of flavor. Aging caused most of the deterioration observed. Inadequate packaging and high store temperatures also contributed to deterioration.

INTRODUCTION

Modern methods of handling, storing, grading, processing, and packaging have improved the quality of dried fruit. Such improvements, however, do not insure the delivery of a uniformly high-quality product to the consumer. Dried fruits deteriorate under retail store conditions (4, 5, 6, 7)[2], and extended shelf life without refrigeration can be obtained only at the expense of fruit quality.

Customer complaints and spot checking of retail stores indicate that deterioration of dried fruit quality actually does occur during marketing. However, a study of dried fruits in market channels was needed to determine the prevalent types of deterioration, its extent, and the important factors leading to deterioration.

METHODS

Sampling

Retail samples were collected by U. S. Department of Agriculture personnel in New York, N. Y.; Chicago, Ill.; Orlando, Fla.; and Fresno, Calif. These cities, differing greatly in climate, represented the major geographical areas of the country. The buyers were instructed to collect a single package of each dried fruit from each of four different stores. They were to buy only certain specified brands and sizes, so that the retail samples could be compared with standard samples stored at Fresno. Both finger packs (a single row of figs, packed tightly on a narrow tray and overwrapped with cellophane) and cartons of figs were included. Buyers were to record the name and type of store, whether the store was air conditioned, and the temperature and relative humidity in the store at the time of sampling.

The age of the retail samples was determined from the code numbers, and represented approximately the number of weeks the sample had been in market channels. The figs and one brand of raisins were not coded. The fruit was of variable age before

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[2] Underlined figures in parenthesis refer to items in Literature Cited, p. 9.

packaging, but since apricots, prunes, and figs are usually stored at a low temperature before processing, this aging was considered negligible in these commodities. Raisins are held in common storage, and some deterioration in storage may be expected.

Standard samples were obtained directly from the packers at intervals during the year and were stored at Fresno in tightly closed drums at 32° F. Medium and large sizes of apricots and prunes, which account for most of the sales volume, were used. Two widely distributed brands of each commodity were included. The first set of standard samples was obtained in October 1959 and was used for comparison with the retail samples at each examination throughout the sampling period. A second set of standards of apricots, prunes, and raisins was obtained in March 1960 and a third set in July 1960, and these were used in addition to the first set. The standard samples for figs were in finger packs, and only one set of standards was used. Standard samples did not change appreciably after they were stored at Fresno, but the raisin standards obtained in March and July were darker than the first set.

Evaluation

After the retail samples were assembled in Fresno, they were opened and photographed in color under standard conditions. The retail samples were rated in comparison with the standard samples for flavor and appearance.

All retail samples considered inedible because of mold or insect infestation were rated zero. Samples so dark that they were considered unacceptable were placed in group 1. Samples obviously poorer than the standard samples, but considered usable, were placed in group 2. The poorer standard samples and retail samples of equal quality were assigned to group 3. The best of the standard samples and the retail samples of equal quality were placed in group 4.

A portion of each sample was ground in a No. 2 food grinder and the percentage moisture was determined with a moisture tester manufactured by the Dried Fruit Association of California. The ethanol-extractable color was determined by the method of Nury, Taylor, and Brekke (4, 5, 6, 7), except that 2-cm. colorimeter tubes were used in place of the 1.2-cm. tubes specified and no correction for moisture was made. Assuming that dried apricots, prunes, and figs average 25 percent moisture, and raisins 15 percent moisture, optical density values in this paper should be multiplied by 0.8 for apricots, prunes, and figs, and by 0.7 for raisins for direct comparison with those given by Nury, Taylor, and Brekke.

The sulfur dioxide concentration in the apricots was determined by the pararosaniline aldehyde method of Nury, Taylor, and Brekke (3). The results were calculated on a dry-weight basis.

The data were analyzed statistically by the analysis of variance. Since the main objective was to determine the conditions leading to a significant change in the retail samples, each sample category was compared independently with the standard samples by the method of least significant differences. The significance of individual factors was determined by the F test. A small number of samples require a greater difference between means for significance than a large number of samples, if the error variance is the same. This fact leads to a few seeming inconsistencies in the analysis of the data, but this need not be confusing if these principles are kept in mind. Only probability levels of 99 percent or greater were considered significant. Any relationship between the various factors was determined by the χ^2 contingency table method.

RESULTS

Apricots

Types of Deterioration

No mold growth or severe sugaring occurred in any of the retail samples. The most prevalent type of deterioration was darkening of the flesh, with concomitant loss of flavor (tables 1 and 2). Only a few samples were infested with insects (table 1). Some retail samples were excessively dry, a condition usually associated with severe darkening.

Extent of Deterioration

The subjective rating for flavor and appearance divided the 124 retail samples into five quality groups (table 1). Seven percent of all the samples collected were unfit for use, and 21 percent were well below the quality of the standards.

The distribution of retail samples into ethanol-extractable color groups paralleled the distribution in the subjective quality rating very closely (table 2). Similar distributions of samples were found in sulfur dioxide concentration groups and moisture content groups (tables 3 and 4). According to the χ^2 analysis, there was a significant relation between the quality rating and ethanol-extractable color, between the rating and sulfur dioxide concentration, and between the rating and moisture. Samples that were rated low in the subjective quality rating were also low in moisture and sulfur dioxide, and high in ethanol-extractable color.

Factors Affecting Deterioration

Age. --Controlled time and temperature studies have shown that deterioration is a function of time at constant temperature (1, 7, 8). This fact was reflected in the sampling data. Samples 50 weeks old or older had an average quality rating of 1.4 (table 6), an average ethanol-extractable color value of 1.35 (table 7), an average sulfur dioxide content of only 433 parts per million (table 8), and an average moisture content of only 17.8 percent (table 9). Each of these values was significantly different from that of the corresponding standard. These extreme values serve to emphasize a trend that was evident after only 20 weeks. Age of the sample, therefore, is a highly important factor contributing to the low quality observed, and 6 percent of the samples were over 50 weeks old. Almost 22 percent of the retail samples were over 30 weeks old (table 5).

Temperature. --Store temperatures in Orlando were generally higher than those in the other cities (table 31). The quality ratings, ethanol-extractable color, and sulfur dioxide content tended to change more rapidly in Orlando than in the other cities (tables 6, 7, and 8). This effect is consistent with the results of controlled experiments in which the rate of darkening increased about 4 times for each 18° F. rise in temperature (8).

Relative humidity. --The relative humidity in stores in eastern cities was higher than in Fresno through much of the year (table 32), but this difference in relative humidity had no marked effect upon the rate of moisture loss from the packages (table 9).

Brand. --The two brands used in the survey differed in type of package and initial sulfur dioxide content of the fruit. The moisture content of apricots in foil-wrapped packages of Brand 1 did not change significantly, but apricots in wax-paper-wrapped packages lost moisture steadily with increasing age. The moisture loss was paralleled by a loss of sulfur dioxide (table 7), which is consistent with the data of Stadtman et al. (9). In other respects, the brands were very similar.

Size. --Medium apricots in the standard samples averaged slightly higher in moisture and in sulfur dioxide content than the large apricots, but these differences were not apparent in the retail samples. The medium apricots also tended to be lower in overall quality than the large ones (table 6), probably because of a larger number of immature fruit.

Prunes

Types of Deterioration

Darkening of the flesh of the prunes, with concomitant loss of flavor, was the only serious form of deterioration found (tables 10 and 11). Some drying occurred in the older samples of Brand 2, but, in general, the distribution of the retail samples into arbitrary moisture groups (table 12) was almost identical to the distribution of standard samples. There was no mold growth, insect infestation, or severe sugaring in any of the retail samples.

Extent of Deterioration

The distribution of retail samples in the subjective quality rating groups illustrates the extent of deterioration (table 10). Almost half of the retail samples were rated lower than any of the standard samples. In ethanol-extractable color, only 7 percent of the standard samples had a value greater than 0.90, but 50 percent of the retail samples were above that value (table 11). There was a statistically significant relation between the quality rating and the ethanol-extractable color value. Samples with a dark flesh color were rated low, and were high in ethanol-extractable color.

Factors Affecting Deterioration

Age. --In controlled experiments, flesh darkening with consequent loss of quality in prunes was a function of time at constant temperature (6). In the sampling data, the average quality rating for Brand 1 fell from 3.4 for samples less than 10 weeks old to 1.8 for samples 40 to 60 weeks old (tables 13 and 14). The average ethanol-extractable color value for Brand 1 increased from 0.76 to 1.19 in samples in those age groups (table 15).

Moisture content was relatively constant in Brand 1 and changed very slowly with time in Brand 2 (table 16).

Age of the sample was a highly important factor contributing to low quality of retail samples. There was a significant relation between the age of the sample and the quality rating (table 14) and between the age and the ethanol-extractable color value (table 15).

Temperature. --The quality ratings and ethanol-extractable color values for prunes tended to change more rapidly in Orlando than in the other cities (tables 14 and 15), probably because of the higher store temperatures there (table 31). This observation is consistent with the results of controlled temperature experiments in which the rate of darkening increased with increasing temperature (1, 6).

Relative humidity. --The relative humidity in stores in eastern cities was higher than in Fresno through much of the year (table 32), and samples of Brand 2 seemed to lose moisture in Fresno slightly faster than in the other cities (table 16).

Brand. --Although the standard samples of the two brands of prunes were similar, the brands responded differently to the market environments. The quality ratings, the ethanol-extractable color values, and the moisture content of Brand 2 samples changed more rapidly with time than samples of Brand 1 (tables 14, 15, and 16). The foil overwrap used for Brand 1 apparently provided a better moisture barrier than the waxed-paper

over-wrap used for Brand 2, and may be responsible for the moisture stability of Brand 1 samples. The other differences between the brands are more difficult to explain and may be due to differences in processing or indirectly to the moisture loss.

Size. --The size of the fruit had no effect on deterioration.

Raisins

Types of Deterioration

Darkening of the flesh, with concomitant loss of flavor, was the most widespread form of deterioration found in raisins. Some drying occurred, but this defect was not serious. Insect infestation was infrequent, but was, of course, highly objectionable. There was no obvious mold growth, and the incidence of mold-damaged raisins appeared to be within grade tolerances. There was no severe sugaring.

Extent of Deterioration

The subjective rating for flavor and appearance of the 128 retail samples is given in table 17. Thirty-eight percent of the retail samples were rated lower in quality than any of the standard samples, and 13 percent were considered unacceptable.

The distribution of the retail samples in ethanol-extractable color groups was similar to the distribution in the quality rating groups (table 18). There was a significant relation between quality rating and ethanol-extractable color.

The two brands differed in the distribution of samples in moisture groups (table 19). Seven percent of the Brand 1 samples and 13 percent of the Brand 2 samples were 2 percentage points dryer than the most frequent moisture group in the standard samples of each brand.

Factors Affecting Deterioration

Age. --Flesh darkening with loss of quality in raisins was a function of time at constant temperature (1, 5). In the retail samples, the average quality ratings of Brand 2 fell from 3.5 for samples less than 10 weeks old to 2.3 for samples over 30 weeks old (tables 20 and 21). The average ethanol-extractable color value increased from 0.40 in samples less than 10 weeks old to 0.93 for samples over 30 weeks old (table 22). There was a significant relation between age of the sample and quality rating and between age and the ethanol-extractable color.

The age of the samples was indicated by code numbers, and the time from harvest to packing could not be determined. If dried fruit is stored at relatively low temperatures before packing, as is usual with apricots and prunes, the age from packing correlates with general deterioration. However, raisins often are stored at very high temperatures before processing, and retail samples packed after March 1 were appreciably lower in quality than fruit of the same code age packed before March 1 (tables 21 and 22). Both the standards and retail samples indicated that deterioration had occurred before processing.

Temperature. --The average quality ratings and ethanol-extractable color values for raisins tended to change more rapidly in Orlando than in the other cities (tables 21 and 22), probably because of the higher store temperatures there (table 31). This observation is consistent with the results of controlled temperature experiments in which the rate of darkening increased with increasing temperature (1, 5).

Relative humidity. --The relative humidity affected the rate of moisture loss. Moisture content was stable only in Orlando, where the relative humidity was consistently high (tables 23 and 32).

Brand.--The brands apparently differed only in moisture content (table 23). The rate of deterioration could not be evaluated for Brand 1, because the retail packages were not coded.

Figs

Types of Deterioration

The most prevalent types of deterioration in dried Calimyrna figs were darkening and loss of flavor. Two samples were infested with insects, but no mold growth or severe sugaring was found.

Extent of Deterioration

The subjective quality rating for flavor and appearance divided the 63 retail samples into 5 groups (table 24). Almost one-half the retail samples rated lower than any of the standard samples. In general, the distribution of samples in ethanol-extractable color groups closely paralleled the distribution in quality rating groups (table 25). According to the χ^2 analysis, there was a significant relation between the quality rating and the ethanol-extractable color.

The moisture content of retail samples in finger packs followed a distribution similar to that of the standard samples (table 26), but the samples in cartons were generally higher in moisture.

Factors Affecting Deterioration

Age.--The fig samples were not coded, so the age of the samples from packing could not be determined. The data were arranged according to the time of sampling. Some of the samples collected during the fall (October to December) were from the new crop and some were obviously from a previous crop year. These two groups could be separated easily and the data are shown separately in the tables. The average rating fell from about 3.0 for new-crop samples to about 1.5 for those from the old crop (tables 27 and 28). A comparable change in ethanol-extractable color was also observed (table 29).

The data from the retail samples of figs are consistent with those from the other commodities and those obtained for figs by Nury, Taylor, and Brekke (4). It was obvious that aging in figs was an important factor contributing to low quality in retail markets.

Temperature and relative humidity.--There were no consistent differences in the retail fig samples which could be attributed to differences in temperature and relative humidity in the different cities. No figs of the brands selected were available in Orlando, so the effect of the more extreme store environments in this city could not be determined.

Brand.--The effect of the brand was complicated by the fact that most of the retail samples of Brand 1 were in foil-wrapped cartons, and most of the retail samples of Brand 2 were in cellophane-wrapped finger packs. Foil-wrapped packages maintained a higher moisture content in the fruit than the cellophane-wrapped packages (table 30). The ethanol-extractable color values were somewhat higher in Brand 1 than in Brand 2 (table 29). This was probably due to a difference in processing, because it is apparent in both standard and retail samples. Since the retail samples were rated in comparison with the standard samples, this difference was not reflected in the quality ratings (table 28).

CONCLUSIONS

The survey shows that deterioration of quality in dried fruits during marketing is a serious problem. The most common form of deterioration was darkening of the flesh. Drying was observed in wax-paper-wrapped packages collected in stores with low relative

humidity. Less drying occurred in foil-wrapped packages. The sample was too small to accurately evaluate the extent of insect infestation or mold growth, but control measures such as refrigeration, which reduce darkening, would incidentally reduce the incidence of such defects (2).

Age was the primary cause of deterioration. This implies that either the stores overstock or fail to rotate their stocks properly. Efforts should be made to insure rapid and complete turnover of retail supplies. Coding and the admonition to rotate stocks printed on each master container do not seem to provide sufficient incentive for good stock rotation. Perhaps dating of the package would provide sufficient consumer pressure to force stock rotation and the removal of old stock from the retail shelves. Temperatures of 50° F. or below would greatly increase the shelf life, if the proper relative humidity were maintained (1, 4, 5, 6, 7). Much additional research is necessary to determine practical solutions to the problems that have been defined and illustrated in this survey.

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APPENDIX

TABLE 1.--Apricots: Distribution of standard and retail samples in quality rating groups

Sample	Rating[1]				
	0	1	2	3	4
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Standard.....	0	0	1	35	64
Retail.....	2	5	14	53	26

[1] See text, p. 4, for description of ratings.

TABLE 2.--Apricots: Distribution of standard and retail samples in groups differing in the optical density of the ethanol-extractable color

Sample	Ethanol-extractable color (optical density)					
	0.00-0.09	0.10-0.19	0.20-0.29	0.30-0.39	0.40-0.99	1.0-2.0
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Standard.....	4	65	31	0	0	0
Retail.....	6	47	28	11	3	4

TABLE 3.--Apricots: Distribution of standard and retail samples in groups differing in sulfur dioxide content

Sample	Sulfur dioxide (p.p.m.)				
	100-990	1000-1990	2000-2990	4000-3990	4000-4990
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Standard.....	0	62	26	4	8
Retail.....	15	44	30	8	3

TABLE 4.--Apricots: Distribution of standard and retail samples in group differing in moisture content

Sample	Moisture (percent)					
	14-19	20-21	22-23	24-25	26-27	28-30
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Standard.....	0	0	28	52	20	0
Retail.....	5	10	38	38	7	2

TABLE 5.--Apricots: Distribution of retail samples into groups differing in brand, size, age, and city

Brand, size, and age of samples	Standard samples	Retail samples				
		New York	Orlando	Chicago	Fresno	Total
	No.					
Brand 1						
Large	20	*No.*	*No.*	*No.*	*No.*	*No.*
6-19 weeks.....		1	0	10	0	11
20-29		3	0	4	0	7
30-39		2	0	3	0	5
40-49		2	0	1	0	3
50-122		0	0	1	0	1
Age unknown		1	0	2	0	3
Medium	20					
6-19 weeks		3	2	7	0	12
20-29		2	0	2	0	4
Age unknown		0	1	1	0	2
Brand 2						
Large	20					
6-19 weeks		3	0	0	0	3
20-29		6	0	0	2	8
30-39		2	0	0	1	3
40-49		2	0	0	0	2
50-122		3	0	0	0	3
Age unknown		1	0	0	0	1
Medium	20					
6-19 weeks		0	7	3	22	32
20-29		0	8	0	1	9
30-39		0	2	0	3	5
40-49		0	0	0	2	2
50-122		0	0	0	3	3
Age unknown		0	1	1	3	5
Total	80	31	21	35	37	124

TABLE 6.--Apricots: Quality rating of standard and retail samples as a function of brand, size, age, and city

Brand, size, and age of samples	Standard samples	Retail samples				
		New York	Orlando	Chicago	Fresno	Average
Brand 1	*Rating*[1]					
Large	3.8	*Rating*	*Rating*	*Rating*	*Rating*	*Rating*
6-19 weeks		3.0	---	3.4	---	3.4
20-29		3.7	---	3.5	---	3.6
30-39		4.0	---	3.7	---	3.8
40-49		[2] 1.5	---	2.0	---	1.7
50-122		---	---	3.0	---	3.0
Age unknown		3.0	---	3.5	---	
Medium	3.5					
6-19 weeks		3.0	3.0	3.1	---	3.1
20-29		3.0	---	4.0	---	3.5
Age unknown		---	2.0	3.0	---	
Brand 2						
Large	3.8					
6-19 weeks		3.3	---	---	---	3.3
20-29		3.0	---	---	3.5	3.1
30-39		3.5	---	---	2.0	3.0
40-49		4.0	---	---	---	4.0
50-122		1.7	---	---	---	1.7
Age unknown		4.0	---	---	---	
Medium	3.3					
6-19 weeks		---	3.1	3.3	3.1	3.1
20-29		---	2.5	---	0.0	2.2
30-39		---	2.0	---	2.7	2.4
40-49		---	---	---	2.5	2.5
50-122		---	---	---	0.7	0.7
Age unknown		---	2.0	3.0	3.0	
Average	3.6	3.0	2.7	3.3	2.7	

[1] See text, p. 4, for description of ratings.
[2] Means underlined are significantly different from the corresponding standard.

TABLE 7.--Apricots: Ethanol-extractable color of standard and retail samples as a function of brand, size, age, and city

Brand, size, and age of samples	Standard samples	Retail samples				
		New York	Orlando	Chicago	Fresno	Average
Brand 1	OD[1]					
Large	0.19	OD	OD	OD	OD	OD
6-19 weeks		0.30	---	0.20	---	0.21
20-29		0.17	---	0.20	---	0.18
30-39		0.24	---	0.24	---	0.24
40-49		[2] 0.47	---	0.32	---	0.42
50-122		---	---	0.30	---	0.30
Age unknown		0.24	---	0.16	---	
Medium	0.20					
6-19 weeks		0.17	0.29	0.20	---	0.21
20-29		0.24	---	0.19	---	0.22
Age unknown		---	0.27	0.24	---	
Brand 2						
Large	0.14					
6-19 weeks		0.19	---	---	---	0.19
20-29		0.20	---	---	0.16	0.19
30-39		0.20	---	---	0.53	0.31
40-49		0.18	---	---	---	0.18
50-122		0.19	---	---	---	1.19
Age unknown		0.08	---	---	---	
Medium	0.16					
6-19 weeks		---	0.20	0.22	0.17	0.18
20-29		---	0.24	---	0.11	0.21
30-39		---	0.34	---	0.20	0.25
40-49		---	---	---	0.37	0.37
50-122		---	---	---	1.87	1.87
Age unknown		---	0.31	0.07	0.19	
Average	0.17	0.31	0.25	0.21	0.33	

[1] Optical density of the 50 percent ethanol extract.
[2] Means underlined are significantly different from the corresponding standard.

TABLE 8.--Apricots: Sulfur dioxide content of standard and retail samples as a function of brand, size, age, and city

Brand, size, and age of samples	Standard samples	Retail samples				
		New York	Orlando	Chicago	Fresno	Average
Brand 1	*P.p.m.*					
Large	1,539	*P.p.m.*	*P.p.m.*	*P.p.m.*	*P.p.m.*	*P.p.m.*
6-19 weeks		660	---	1,889	---	1,777
20-29		1,993	---	2,268	---	2,150
30-39		985	---	1,800	---	1,474
40-49		660	---	860	---	727
50-122		---	---	1,130	---	1,130
Age unknown		1,460	---	1,575	---	
Medium	1,731					
6-19 weeks		1,680	1,175	1,923	---	1,740
20-29		1,360	---	1,300	---	1,332
Age unknown		---	1,440	880	---	
Brand 2						
Large	2,428					
6-19 weeks		1,840	---	---	---	1,840
20-29		1,958	---	---	2,835	2,178
30-39		1,580	---	---	1,450	1,537
40-49		2,180	---	---	---	2,180
50-122		[1] 463	---	---	---	463
Age unknown		3,570	---	---	---	
Medium	2,834					
6-19 weeks		---	1,959	2,073	2,718	2,492
20-29		---	1,231	---	2,130	1,331
30-39		---	840	---	2,383	1,766
40-49		---	---	---	1,975	1,975
50-122		---	---	---	170	170
Age unknown		---	1,240	3,770	2,233	
Average	2,133	1,578	1,441	1,869	2,285	

[1] Means underlined are significantly different from the corresponding standard.

TABLE 9.--Apricots: Moisture content of standard and retail samples as a function of brand, size, age, and city

Brand, size, and age of samples	Standard samples	Retail samples				
		New York	Orlando	Chicago	Fresno	Average
Brand 1	Pct.					
Large	23.9	Pct.	Pct.	Pct.	Pct.	Pct.
6-19 weeks		24.5	---	24.9	---	24.8
20-29		24.0	---	24.0	---	24.0
30-39		24.3	---	23.8	---	24.0
40-49		23.3	---	22.5	---	23.0
50-122		---	---	23.0	---	23.0
Age unknown		[1] 28.0	---	25.5	---	
Medium	25.3					
6-19 weeks		25.5	23.8	24.0	---	24.3
20-29		27.0	---	25.0	---	26.0
Age unknown		---	24.0	23.0	---	
Brand 2						
Large	24.2					
6-19 weeks		22.0	---	---	---	22.0
20-29		22.6	---	---	21.8	22.4
30-39		22.0	---	---	17.5	20.5
40-49		21.5	---	---	---	21.5
50-122		18.3	---	---	---	18.3
Age unknown		23.5	---	---	---	
Medium	25.2					
6-19 weeks		---	23.6	24.2	24.3	24.1
20-29		---	23.3	---	21.0	23.0
30-39		---	21.5	---	22.5	22.1
40-49		---	---	---	21.3	21.3
50-122		---	---	---	15.5	15.5
Age unknown		---	23.0	25.5	23.7	
Average	24.6	23.1	23.2	24.3	22.8	

[1] Means underlined are significantly different from the corresponding standard.

TABLE 10.--Prunes: Distribution of standard and retail samples in quality rating groups

Sample	Rating[1]				
	0	1	2	3	4
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Standard	0	0	0	29	71
Retail	0	11	35	36	18

[1] See text, p. 4, for description of ratings.

TABLE 11.--Prunes: Distribution of standard and retail samples in groups differing in ethanol-extractable color

Sample	Ethanol-extractable color (optical density)				
	0.40-0.69	0.70-0.89	0.90-1.09	1.10-1.29	1.3-2.0
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Standard	28	65	7	0	0
Retail	16	34	28	13	9

TABLE 12.--Prunes: Distribution of standard and retail samples in groups differing in moisture content

Sample	Moisture (percent)			
	20.0-21.5	22.0-23.5	24.0-25.5	26.0-28.5
	Pct.	*Pct.*	*Pct.*	*Pct.*
Standard	4	29	53	14
Retail	3	29	47	21

TABLE 13.--Prunes: Distribution of retail samples into groups differing in brand, age, and city

Brand and age of samples	Standard samples	Retail samples				
		New York	Orlando	Chicago	Fresno	Total
	No.					
Brand 1	36					
		No.	*No.*	*No.*	*No.*	*No.*
0-9 weeks		1	3	10	2	16
10-19		16	4	7	3	30
20-29		6	6	4	4	20
30-39		0	3	1	2	6
40-60		1	0	0	5	6
Age unknown		--	--	1	--	1
Brand 2	36					
0-9 weeks		2	5	3	5	15
10-19		7	6	4	6	23
20-29		5	2	1	6	14
30-39		1	3	0	2	6
Total	72	39	32	31	35	137

TABLE 14.--Prunes: Quality rating of standard and retail samples as a function of brand, age, and city

Brand and age of samples	Standard samples	Retail samples				
		New York	Orlando	Chicago	Fresno	Average
	Rating[1]					
Brand 1	3.75					
		Rating	*Rating*	*Rating*	*Rating*	*Rating*
0-9 weeks		4.0	2.7	3.7	3.0	3.4
10-19		3.2	[2] 2.3	2.6	2.3	2.8
20-29		3.2	2.2	2.3	2.2	2.5
30-39		---	2.0	4.0	2.0	2.2
40-60		2.0	---	---	1.8	1.8
Age unknown		---	---	3.0		
Brand 2	3.67					
0-9 weeks		3.0	2.6	3.0	3.2	2.9
10-19		2.4	2.5	2.0	2.7	2.4
20-29		2.4	1.0	1.0	2.3	2.1
30-39		3.0	2.0	---	1.0	1.8
Average	3.71	2.9	2.3	2.8	2.4	

[1] See text, p. 4, for description of ratings.
[2] Means underlined are significantly different from the corresponding standard.

TABLE 15.--Prunes: Ethanol-extractable color of standard and retail samples as a function of brand, age, and city

Brand and age of samples	Standard samples	Retail samples				
		New York	Orlando	Chicago	Fresno	Average
	OD[1]					
Brand 1	0.79					
		OD	OD	OD	OD	OD
0-9 weeks		0.63	0.94	0.72	0.77	0.76
10-19		0.85	0.95	0.82	0.73	0.84
20-29		0.84	0.97	0.87	0.74	0.86
30-39		---	0.81	0.97	1.10	0.94
40-60		[2] 1.50	---	---	1.12	1.19
Age unknown		---	---	1.00	---	
Brand 2	0.76					
0-9 weeks		0.60	0.72	0.95	1.06	0.86
10-19		0.88	1.13	1.18	0.89	1.00
20-29		0.84	1.25	1.10	1.08	1.02
30-39		0.82	1.45	---	1.18	1.26
Average	0.77	0.85	1.01	0.86	0.97	

[1] Optical density of the 50 percent ethanol extract.
[2] Means underlined are significantly different from the corresponding standard.

TABLE 16.--Prunes: Moisture content of standard and retail samples as a function of brand, age, and city

Brand and age of samples	Standard samples	Retail samples				
		New York	Orlando	Chicago	Fresno	Average
	Pct.					
Brand 1	24.8					
		Pct.	Pct.	Pct.	Pct.	Pct.
0-9 weeks		26.5	26.0	25.7	26.0	25.8
10-19		24.3	24.0	24.9	25.5	24.5
20-29		24.5	25.7	24.3	25.5	25.0
30-39		---	23.8	23.5	23.2	23.6
40-60		25.5	---	---	24.4	24.6
Age unknown		---	---	23.5	---	
Brand 2	24.0					
0-9 weeks		23.8	[1] 25.6	23.8	24.1	24.5
10-19		23.4	24.3	24.1	24.7	24.1
20-29		23.7	24.0	22.0	23.3	23.5
30-39		23.0	23.3	---	21.5	22.7
Average	24.4	24.1	24.7	24.7	24.3	

[1] Means underlined are significantly different from the corresponding standard.

TABLE 17.--Raisins: Distribution of standard and retail samples in quality rating groups

Sample	Rating[1]				
	0	1	2	3	4
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Standard.....	0	0	0	22	78
Retail.....	1	12	25	44	18

[1] See text, p. 4, for description of ratings.

TABLE 18.--Raisins: Distribution of standard and retail samples in groups differing in ethanol-extractable color

Sample	Ethanol-extractable color (optical density)				
	0.2-0.4	0.5-0.7	0.8-1.0	1.1-1.3	1.4-2.0
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Standard.....	25	68	7	0	0
Retail.....	23	38	21	13	5

TABLE 19.--Raisins: Distribution of standard and retail samples in groups differing in moisture content

Brand and sample	Moisture (percent)							
	10	11	12	13	14	15	16	17-19
Brand 1	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Standard.....	0	0	55	5	15	20	0	5
Retail.....	7	19	24	19	19	12	0	0
Brand 2								
Standard.....	0	0	0	5	30	25	25	15
Retail.....	0	4	9	9	9	24	41	4

TABLE 20.--Raisins: Distribution of standard and retail samples into groups differing in brand, age, and city

Brand, date packed, and age of samples	Standard samples	Retail samples				
		New York	Orlando	Chicago	Fresno	Total
	No.					
Brand 1	20	*No.*	*No.*	*No.*	*No.*	*No.*
Age unknown		20	8	2	12	42
Brand 2						
Packed before Mar. 1	10					
0-9 weeks		2	0	4	8	14
10-19		2	2	3	3	10
20-29		4	4	0	0	8
30-57		2	6	0	1	9
Packed after Mar. 1	10					
0-9 weeks		0	0	2	7	9
10-19		8	2	4	5	19
20-29		1	7	0	0	8
30-57		3	5	0	0	8
Age unknown		-	-	1	-	1
Total (Brand 2)		22	26	14	24	86
Grand total	40	42	34	16	36	128

TABLE 21.--Raisins: Quality rating of standard and retail samples as a function of brand, age, and city

Brand, date packed, and age of samples	Standard samples	Retail samples				
		New York	Orlando	Chicago	Fresno	Average
	Rating[1]					
Brand 1	3.9	*Rating*	*Rating*	*Rating*	*Rating*	*Rating*
Age unknown		[2] 2.7	2.6	2.0	3.0	2.7
Brand 2						
Packed before Mar. 1	3.6					
0-9 weeks		3.0	---	3.3	3.8	3.5
10-19		3.0	3.5	2.7	3.3	3.1
20-29		2.5	2.5	---	---	2.5
30-57		3.0	2.2	---	2.0	2.3
Packed after Mar. 1	4.0					
0-9 weeks		---	---	2.5	3.1	3.0
10-19		2.4	2.5	2.5	2.8	2.5
20-29		2.0	1.6	---	---	1.6
30-57		2.0	1.4	---	---	1.6
Age unknown		---	---	4.0	---	---
Average (Brand 2)		2.5	2.0	2.5	3.3	2.6

[1] See text, p. 4, for description of ratings.
[2] Means underlined are significantly different from the corresponding standard.

TABLE 22.--Raisins: Ethanol-extractable color of standard and retail samples as a function of brand, age, and city

Brand, date packed, and age of samples	Standard samples	Retail samples				
		New York	Orlando	Chicago	Fresno	Average
	OD[1]					
Brand 1	0.54	OD	OD	OD	OD	OD
Age unknown		[2] 0.79	0.77	0.59	0.52	0.70
Brand 2						
Packed before Mar. 1	0.58					
0-9 weeks		0.78	---	0.34	0.34	0.40
10-19		0.37	0.48	0.61	0.60	0.53
20-29		0.52	0.71	---	---	0.62
30-57		0.67	0.92	---	1.10	0.93
Packed after Mar. 1	0.73					
0-9 weeks		---	---	0.97	0.72	0.78
10-19		0.86	1.48	0.84	0.76	0.90
20-29		0.68	1.08	---	---	1.03
30-57		1.11	1.10	---	---	1.10
Age unknown		---	---	0.55	---	
Average (Brand 2)		0.76	0.99	0.65	0.60	0.76

[1] Optical density of 50 percent ethanol extract.
[2] Means underlined are significantly different from the corresponding standard.

TABLE 23.--Raisins: Moisture content of standard and retail samples as a function of brand, age, and city

Brand, date packed, and age of samples	Standard samples	Retail samples				
		New York	Orlando	Chicago	Fresno	Average
	Pct.					
Brand 1	13.5	Pct.	Pct.	Pct.	Pct.	Pct.
Age unknown		13.1	12.9	[1] 10.8	12.5	12.8
Brand 2						
Packed before Mar. 1	15.8					
0-9 weeks		15.5	---	15.0	15.9	15.6
10-19		15.0	16.3	12.7	14.7	14.5
20-29		13.3	16.1	---	---	14.7
30-58		13.8	15.7	---	12.0	14.8
Packed after Mar. 1	14.5					
0-9 weeks		---	---	15.0	14.9	14.9
10-19		14.8	14.8	15.5	15.0	15.0
20-29		11.0	15.9	---	---	15.3
30-58		13.2	15.7	---	---	14.8
Age unknown		---	---	18.0	---	
Average (Brand 2)	15.1	14.1	15.8	14.9	15.1	15.0

[1] Means underlined are significantly different from the corresponding standard.

TABLE 24.--Figs: Distribution of standard and retail samples in quality rating groups

Sample	Rating[1]				
	0	1	2	3	4
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Standard	0	0	0	12	88
Retail	3	14	32	38	13

[1] See text, p. 4, for description of ratings.

TABLE 25.--Figs: Distribution of standard and retail samples in groups differing in ethanol-extractable color

Sample	Ethanol-extractable color (optical density groups)				
	0.1-0.3	0.4-0.6	0.7-0.9	1.0-1.2	1.3-2.0
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Standard	6	50	44	0	0
Retail	5	24	38	19	14

TABLE 26.--Figs: Distribution of standard and retail samples in groups differing in moisture content

Sample and type of package	Moisture (percent)						
	21	22	23	24	25	26	27-28
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Standard							
Finger packs	9	18	53	14	0	3	3
Retail							
Finger packs	6	11	26	34	20	3	0
Cartons	0	4	14	7	25	39	11

TABLE 27.--Figs: Distribution of standard and retail samples into groups differing in brand, season, and city

Brand and season	Standard samples	Retail samples			
		New York	Chicago	Fresno	Total
	No.				
Brand 1	17	*No.*	*No.*	*No.*	*No.*
Oct. - Dec. (new crop)		4	5	0	9
Jan. - Mar.		1	1	0	2
Apr. - Sept.		3	5	0	8
Oct. - Dec. (old crop)		3	3	0	6
Brand 2	17				
Oct. - Dec. (new crop)		5	3	4	12
Jan. - Mar.		5	11	1	17
Apr. - Sept.		0	5	0	5
Oct. - Dec. (old crop)		0	2	2	4
Total	34	21	35	7	63

TABLE 28.--Figs: Quality rating of standard and retail samples as a function of brand, season, and city

Brand and season	Standard	Retail samples			
		New York	Chicago	Fresno	Average
	Rating[1]				
Brand 1	3.9	*Rating*	*Rating*	*Rating*	*Rating*
Oct. - Dec. (new crop)		[2] 2.8	2.6	---	2.7
Jan. - Mar.		2.0	4.0	---	3.0
Apr. - Sept.		3.0	1.8	---	2.3
Oct. - Dec. (old crop)		1.7	1.3	---	1.5
Brand 2	3.9				
Oct. - Dec. (new crop)		3.0	3.3	3.5	3.3
Jan. - Mar.		2.6	2.6	0.0	2.5
Apr. - Sept.		---	1.8	---	1.8
Oct. - Dec. (old crop)		---	2.5	0.5	1.5
Average	3.9	2.6	2.4	2.1	

[1] See text, p. 4, for description of ratings.
[2] Means underlined are significantly different from the corresponding standard.

TABLE 29.--Figs: Ethanol-extractable color of standard and retail samples as a function of brand, season, and city

Brand and season	Standard samples	Retail samples			
		New York	Chicago	Fresno	Average
	OD[1]				
Brand 1	0.81	*OD*	*OD*	*OD*	*OD*
Oct. - Dec. (new crop)		0.50	0.74	---	0.63
Jan. - Mar.		1.05	1.10	---	1.08
Apr. - Sept.		[2] 1.14	1.25	---	1.21
Oct. - Dec. (old crop)		1.45	1.56	---	1.50
Brand 2	0.47				
Oct. - Dec. (new crop)		0.65	0.53	0.55	0.59
Jan. - Mar.		0.74	0.80	1.30	0.81
Apr. - Sept.		---	1.01	---	1.01
Oct. - Dec. (old crop)		---	1.45	1.02	1.23
Average	0.64	0.85	0.96	0.79	

[1] Optical density of the 50 percent ethanol extract.
[2] Means underlined are significantly different from the corresponding standard.

TABLE 30.--Figs: Moisture content of standard and retail samples as a function of brand, season, and city

Brand and season	Standard samples	Retail samples			
		New York	Chicago	Fresno	Average
	Pct.				
Brand 1	23.0	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Oct. - Dec. (new crop)		24.8	25.1	---	24.9
Jan. - Mar.		26.0	26.0	---	26.0
Apr. - Sept.		25.5	24.6	---	24.9
Oct. - Dec. (old crop)		[1] 26.0	24.7	---	25.3
Brand 2	23.6				
Oct. - Dec. (new crop)		23.7	25.0	24.8	24.4
Jan. - Mar.		22.9	24.6	21.5	23.9
Apr. - Sept.		---	24.3	---	24.3
Oct. - Dec. (old crop)		---	24.5	24.5	24.5
Average	23.3	24.4	24.7	24.2	

[1] Means underlined are significantly different from the corresponding standard.

TABLE 31.--Average store temperature at time of sampling

Samplings		City			
Number	Date	New York	Orlando	Chicago	Fresno
		°F	°F	°F	°F
1	Nov. 23 - Dec. 2, 1959	66	78	75	69
2	Dec. 21 - 22, 1959	62	70	73	--
3	Jan. 18 - Feb. 1, 1960	67	79	72	--
4	Feb. 17 - 24, 1960	66	71	74	--
5	Mar. 17 - 24, 1960	64	71	72	73
6	May 9 - 13, 1960	69	77	73	71
7	July 5 - 18, 1960	73	82	72	74
8	Aug. 29 - Sept. 13, 1960	78	81	74	70
9	Oct. 28 - Nov. 2, 1960	66	80	73	67
10	Nov. 21 - 25, 1960	65	78	72	67

TABLE 32.--Average relative humidity in stores at time of sampling

Samplings		City			
Number	Date	New York	Orlando	Chicago	Fresno
		Pct.	Pct.	Pct.	Pct.
1	Nov. 23 - Dec. 2, 1959	47	70	--	39
2	Dec. 21 - 22, 1959	37	72	62	--
3	Jan. 18 - Feb. 1, 1960	33	66	60	--
4	Feb. 17 - 24, 1960	46	67	58	--
5	Mar. 17 - 24, 1960	68	76	54	--
6	May 9 - 13, 1960	39	50	59	39
7	July 5 - 18, 1960	49	65	60	42
8	Aug. 29 - Sept. 13, 1960	66	68	62	40
9	Oct. 28 - Nov. 2, 1960	58	52	63	41
10	Nov. 21 - 25, 1960	67	59	65	46

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