TIME TEMPERATURE STORAGE STUDY OF DRIED APPLES AND HEAT TREATED GROUND RAISINS

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APPLES

Apples comprise one of the largest fruit crops in the United States, with an annual production of about 3 million tons. Even though the major portion of the crop is consumed in the fresh state, a large tonnage is still preserved by dehydration. Processors and consumers alike are interested in the final quality of the dehydrated product. In dried apples this "quality" is usually associated with the whiteness of the fruit as well as with flavor.

Various cut dried fruits have been shown to darken readily during high temperature storage. This study was undertaken to determine the effect of various storage temperatures on the quality of commercially packaged apples.

Materials and Methods

Two lots of dried apples were obtained from a commercial packer in 8 oz. retail pouches. One lot was packaged in a metal foil laminate pouch and the other lot was sealed in Viso-pack material (Plyo-film). Twenty bags were used from each lot. These were stored in chambers at constant temperature (50, 70, and 90° F) and relative humidity (60%). Four packages were removed periodically from each chamber for evaluation as follows:

Alcohol extractable color - The alcohol extractable color was determined according to the procedure outlined by Nury (2) where a 0.53 oz. sample of ground dried fruit was soaked in 6.7 oz. of 50% ethanol for 23 hours. The absorbance of the filtered solution was then determined at 440 mu.

Moisture determination - Moisture determinations were made by the vacuum-oven method according to the procedure of the Association of Official Agricultural Chemists (1) as modified by Nury et al. (2).

Sugars - The method of Munson-Walker (1) was employed for total and reducing sugars and that of Williams and Potter (3) for levulose determination. Dextrose and sucrose were determined by difference.

Visual and tactile changes - The samples which were withdrawn from various analyses were examined for changes in texture, occurrence of sugaring, and growth of micro-organisms. In addition, color photos of a representative portion of the fruits were taken.

Weight changes in retail packages - Four commercially produced retail packages of each dried fruit were weighed periodically throughout the experiments. The weight changes in these unopened packages were expressed as percentage of the original weight.

Sulfur dioxide - The sulfur dioxide content of the fruit was determined by the gravimetric Monier-Williams (1) procedure.

Taste panel - A taste panel consisting of 16 judges made a total of 32 judgments. Each panel member was given 2 separate sets of 3 samples consisting of either 2 treated and 1 control or 1 treated and 2 controls in an unknown order. The judge was required to match like samples within each set.

Results and Discussion

Composition of dried apples used in this study is indicated in Figure 1.

Color change - The darkening of the apples was followed by measuring the absorbance of the alcohol-extractable color. The absorbance curves for the two types of packaging were similar. Figure 2 shows the curves for foil-packaged apples. Apples that resulted in absorbance at 0.12 or over were considered to be too dark for commercial acceptance. This corresponds to a shortage life of about 2 to 3 months at 90°, 10 months at 70°, and over 12 months at 50° F. In both types of packaging, the apples exhibited a certain lag phase during the first few weeks of storage before they began to darken. The higher the temperature the shorter and less pronounced was the lag phase.

Sulfur dioxide changes - The rate of sulfur dioxide loss was about the same for the apples packaged in both types of pouch. Figure 3 shows SO_2 loss in foil bags. Higher temperatures greatly accelerated sulfur dioxide loss. The average sulfur dioxide losses for the apples stored at 50, 70, and 90° F. were 3.8, 7.3, and 20.0 p.p.m. per day, respectively. The sulfur dioxide loss almost doubled with change in storage temperature from 50° to 70° F. and essentially tripled between 70° and 90° F.

Weight changes - Weight losses differed markedly between the two lots packaged in foil and Plyo-film (Figure 4). Apples packaged in foil lost very little weight even when held at 90° F. for 5 months; in contrast, Plyo-film packaged apples lost moisture excessively even when stored at lower temperatures. This would indicate that the apples packaged in Viso-pak bags would have to be over-filled to insure an adequate net weight if stored for an extended time.

Visual changes - The apples were photographed periodically. There was no visible difference in the apples during their storage at 50° F. However, apples stored at 70° F. were brown after 360 days' storage (Figure 5). Apples stored at 90° F. were brown in 120 days (Figure 6). No microbial growth or insect infestation was observed in any of the packages.

Flavor changes - A flavor difference was detected in the apples after they had been stored at 90° F. for 10 weeks. At that time, the taste panel made 50% correct judgments, which is significant at the 5% level. However, even though the panel could distinguish a flavor difference, their indicated preference for the control or stored apple was not significant. This means that even though a noticeable flavor difference existed, it was not objectionable. No significant flavor difference was detected in the dried apples stored for 8 months at 70° F.

Summary

Higher temperature (90°) had a very detrimental effect on dried apples by causing accelerated loss of SO_2 and darkening. This suggests that dried apples should be stored at lower temperatures in order to retain light color for a long time. The maximum storage before they began to brown extensively was 2-3 months at 90° F. and 10 months at 70° F. Packaging material was also important. With a packaging material that was not fairly impermeable to moisture, weight loss was rapid, especially at high temperatures.

RAISINS

Raisins are an energy-rich, nutritious food with many uses. A large tonnage is consumed annually in small convenient retail packages. In addition, raisins are used in combination with other products, such as cereals, candies and bakery goods. Limited amounts of raisins are used in the ground form in bakers' recipes. However, to use them, the individual baker must grind them himself. He has not been able to buy raisins in the ground form, like other dried fruits, because they harden to a crystalline block a short time after grinding.

A couple of methods to retard hardening of ground raisins have been developed at our laboratory. Both treatments provide ground raisins that remain soft during months of storage. However, for commercial acceptability, information is needed on storage stability. The present study was undertaken to provide this information.

Materials and Methods

Regular 1965 crop raisins of 16.5% moisture were obtained from a commercial packer. Ground raisins were produced by passing the raisins through a grinder equipped with a head containing 0.2-in. diameter holes. In the treatment that consists of grinding and then heating (GTH) the ground raisins were put into a 120° F. oven and held for 2 days. In the treatment where the raisins were ground hot (GH), the whole raisins were heated by using hot air followed by steam. In this heating operation, approximately 3 pounds of raisins were spread on a 2-foot square stainless-steel tray that was then put into a 195° F. dehydrator for 3 minutes. Next the tray was removed from the dehydrator and put immediately into a steam blancher for 21 seconds. The raisins were then ground and packaged, with the final temperature being slightly over 150° F. The final moisture content of the product was 18%.

Alcohol-extractable color was determined as described earlier for apples. Texture measurements were made with a Kramer Shear Press*. A reading of about 800 pounds was considered to be the limit for a spreadable and easy to handle product.

Results and Discussion

Triangle taste panels were conducted as described earlier. A taste panel was used first to determine if heat treating by either method produced a noticeable flavor difference in the final products. When untreated and GTH-treated pastes were given to the panel, only 33% provided correct answers;

this level isn't significant. However, when the same panel was given untreated and GH-treated pastes, 67% provided correct answers; this is a significant level. Of the 67% that were correct, 88% preferred the untreated product. Even though the panel preferred the untreated paste, they did not indicate that the treated raisins had an objectionable taste. The authors feel that the GH-treated raisins do not have as much distinctive raisin flavor as the GTH product.

When the raisin pastes were stored at 90° and 70° F, the panel was able to distinguish a difference (50% correct judgments) in the GTH product at 4 and 16 weeks respectively and in the GH samples stored at 90° and 70° F. at about 16 weeks (Figures 7 and 8). The reason the GH sample did not develop noticeable flavor difference at 90° for a relatively long time, compared with the GTH sample, is probably because the GH sample did not have as much flavor originally. It should be pointed out also that where the panel members could distinguish a difference, they indicated that the products still did not have an objectionable flavor.

The change in texture of the samples was determined periodically during storage. The untreated samples became hard within a week or two after grinding (Figures 9 and 10); those stored at higher temperature hardened less. The GH product hardened more rapidly than did the GTH. Here again storage temperature had an effect, with samples stored at 90° F. remaining soft longer than those stored at 70° F. GTH raisins remained spreadable for 6 months when held at 70° F.

A texture difference became noticeable after 24 weeks in samples stored at 70° F; they began to crystallize and develop a gritty texture. The change was less in the GTH sample. No crystallization was noticed in samples stored at 90° F.

Absorbance of the alcohol-extractable color of the ground raisins indicated that they darkened at essentially the same rate when stored at the same temperatures (Figures 11 and 12). By comparison, whole raisins darkened faster than the ground product. The reason may be that the ground raisins have less surface area in contact with air than do whole ones. An informal panel indicated that the control and samples stored differed slightly in darkening after about 28 weeks. A detectable visual difference is equivalent to an absorbance of 0.7. However, the samples were not considered objectionably dark until they had reached an absorbance of about 1.0.

To summarize the results of this storage study, both treatment procedures produced a good product. However, the best product seemed to be obtained by heating the raisins after grinding. This heat-treated material retained its soft and spreadable texture, natural color and good flavor for at least 6 months during storage.

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*Reference to a company or product name does not imply approval or recommendation of the product by the U.S. Department of Agriculture to the exclusion of others that may be suitable.

(5/23/67)

REFERENCES

1. Association of Official Agricultural Chemists. 1965. Official Methods of Analysis. Ed. 10, Sec. 20.009, 29.038 and 27.080.

2. Nury, F.S., Taylor D.H. and Brekke, J. E. 1960. Research for Better Quality in Dried Fruits, Apricots. U. S. Dept. Agr., ARS-74-19.

3. Williams, K.T. and Potter, E.F. 1958. Report on Sugars in Plants. S. Assoc. Off. Agr. Chem. 41(2): 307-309.

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DRIED APPLE COMPOSITION

		Foil Pouch %	Plyo-film Bag %
Moisture		24.7	24.4
Sulfur Dioxide		0.2430	0.2255
Sugar	Total	42.5	42.8
	Reducing	40.5	40.7
	Fructose	33.0	33.9
Crude Fiber		3.4	3.5
Nitrogen		0.11	0.12
Ash		1.2	1.2
Acidity (calc.as malic)		2.1	2.1

Figure 1.

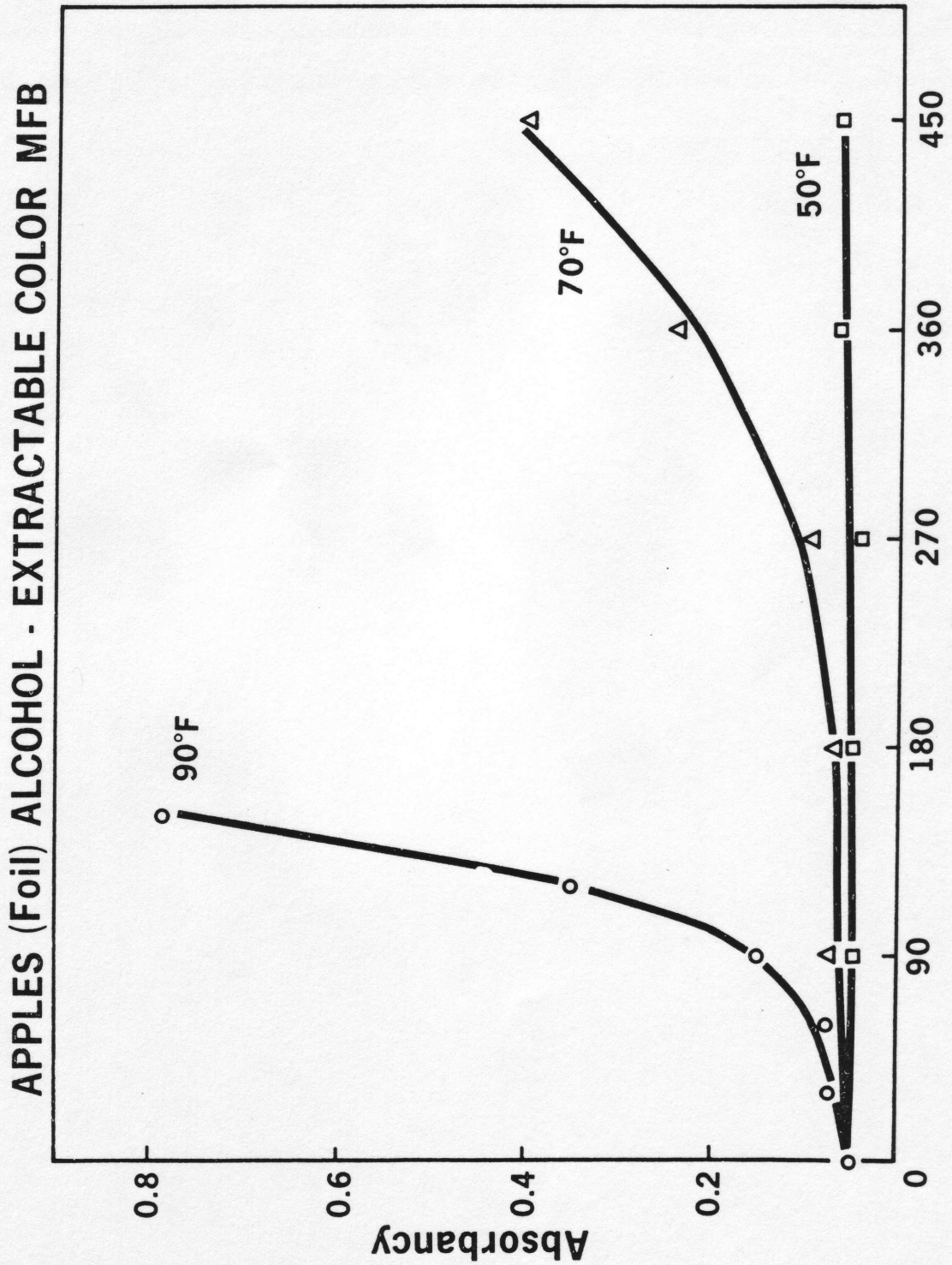

Figure 2 - Alcohol extractable color of foil packaged apples.

expressed on moisture free basis (MFB).

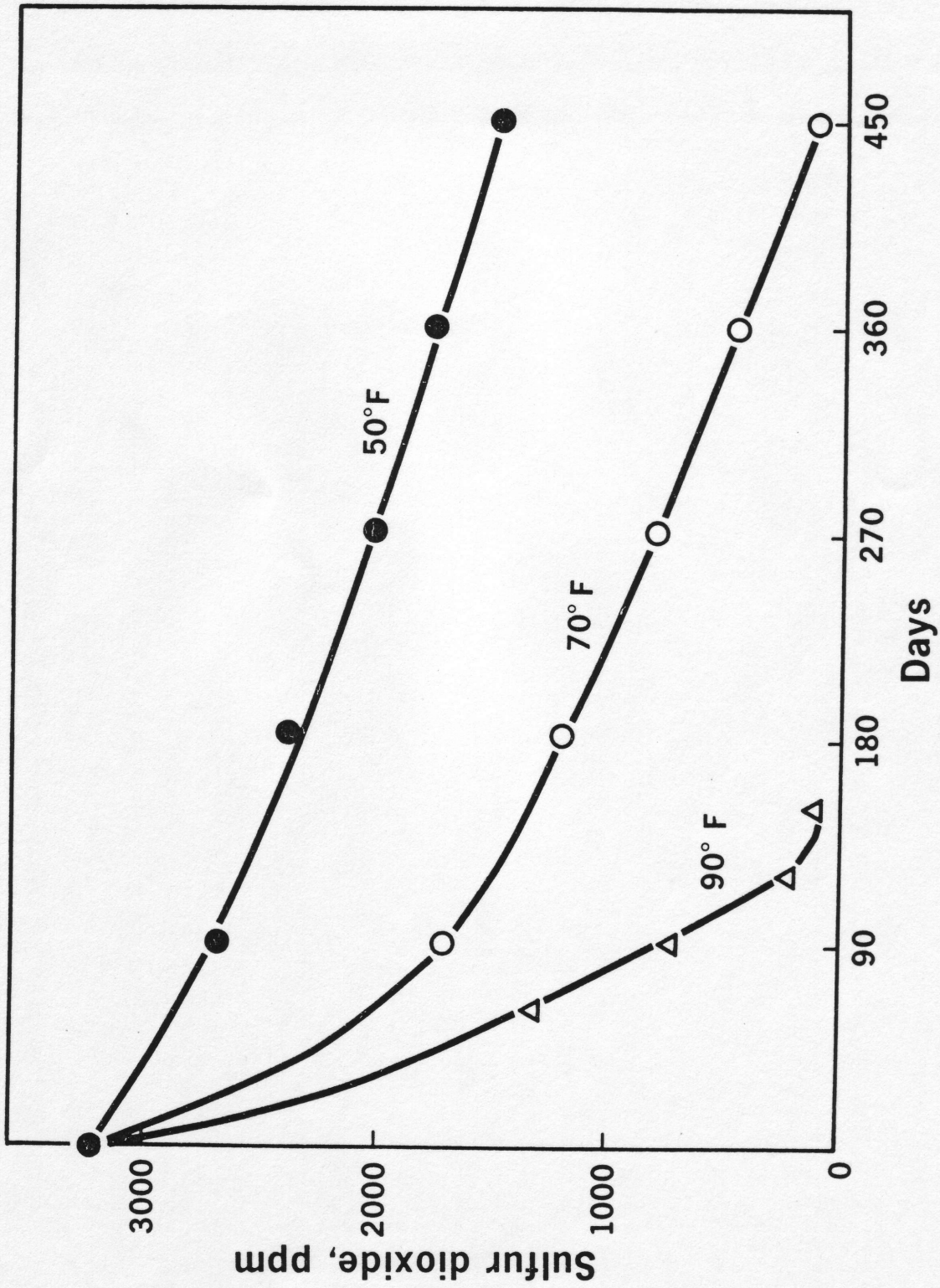

Figure 3 - Sulfur dioxide loss of foil package of apples during storage.

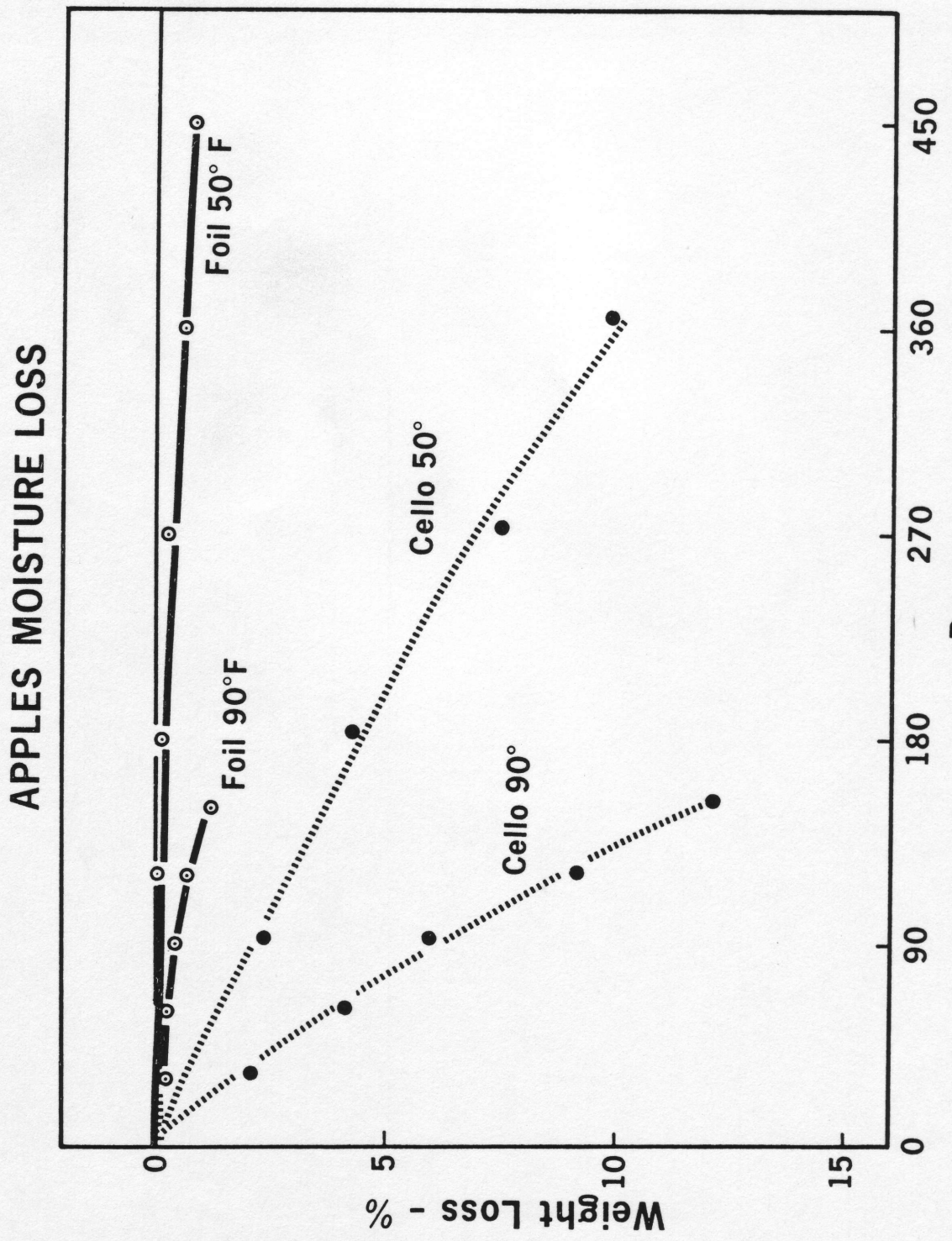

Figure 4 - Weight loss of apples stored at 50° and 90°F.

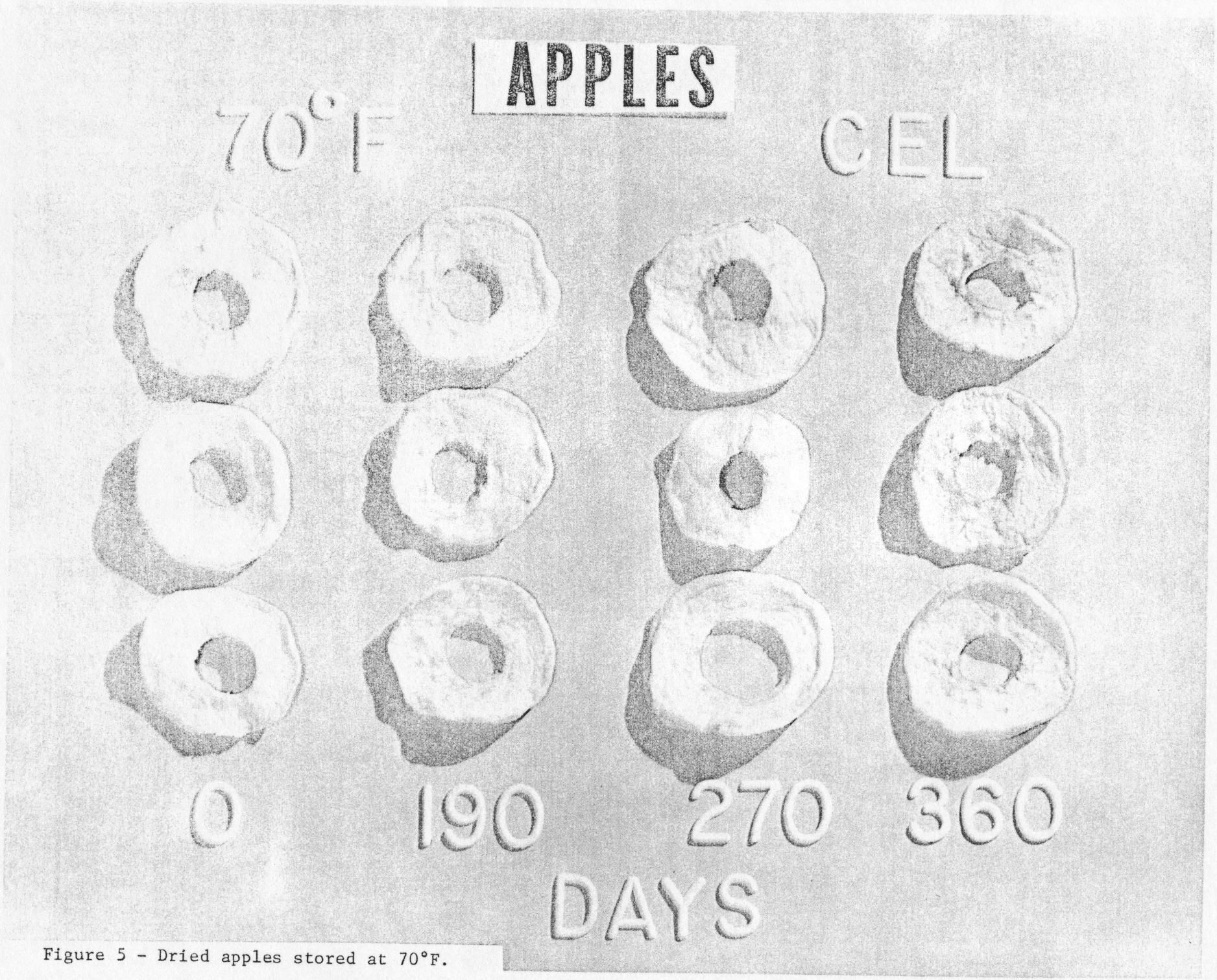

Figure 5 - Dried apples stored at 70°F.

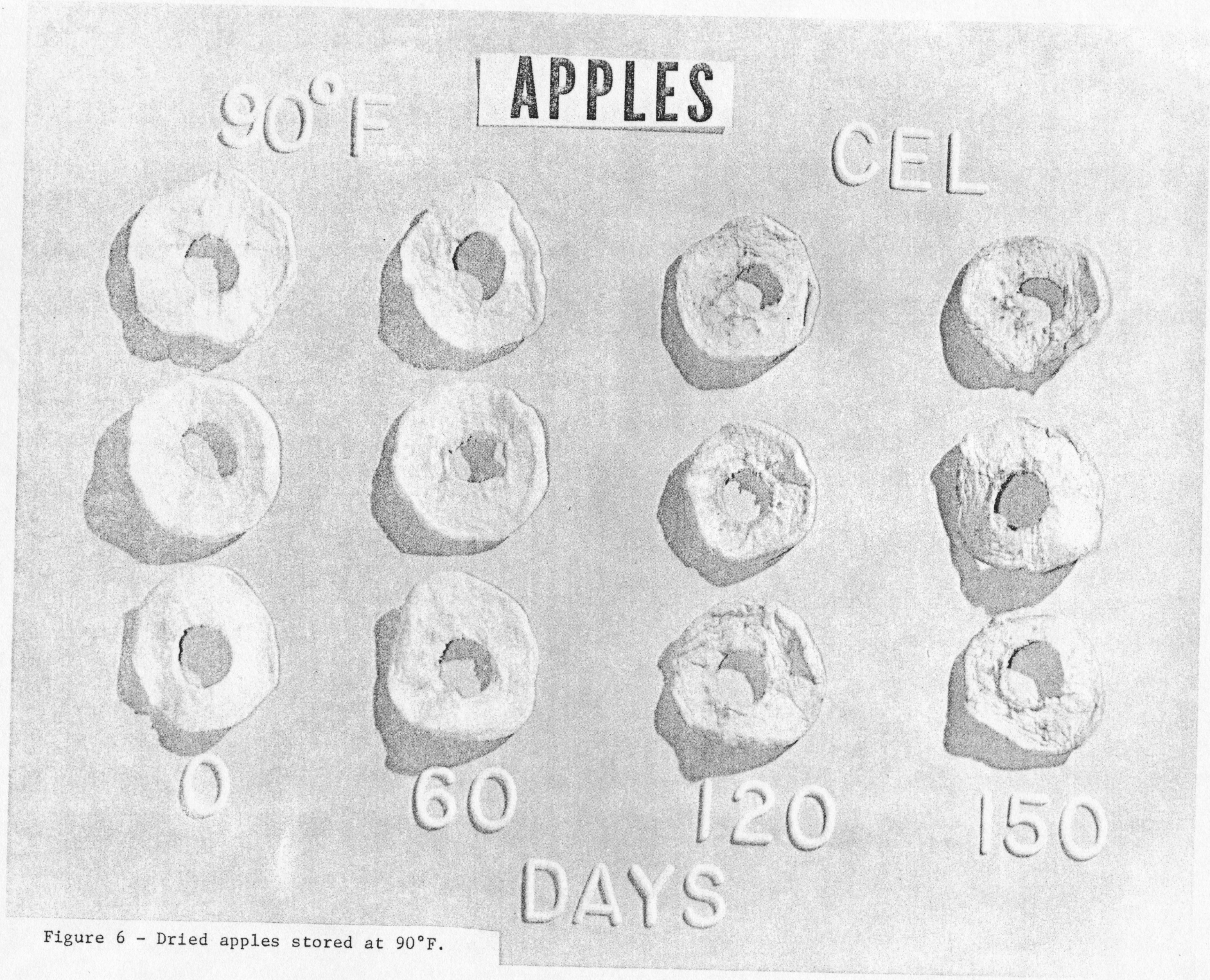

Figure 6 - Dried apples stored at 90°F.

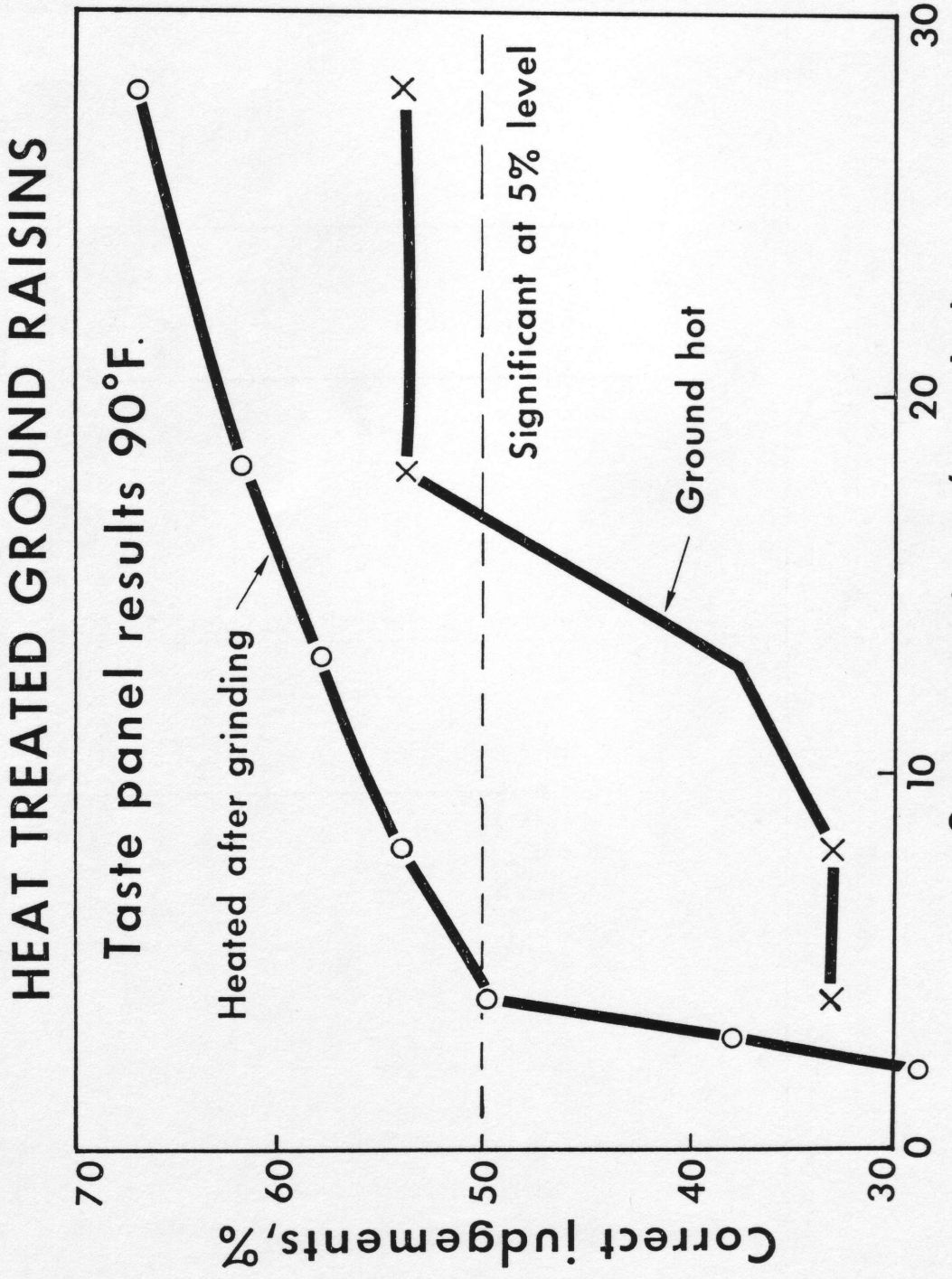

Figure 7 - Flavor difference developed in heat treated ground raisins during storage at 90°F.

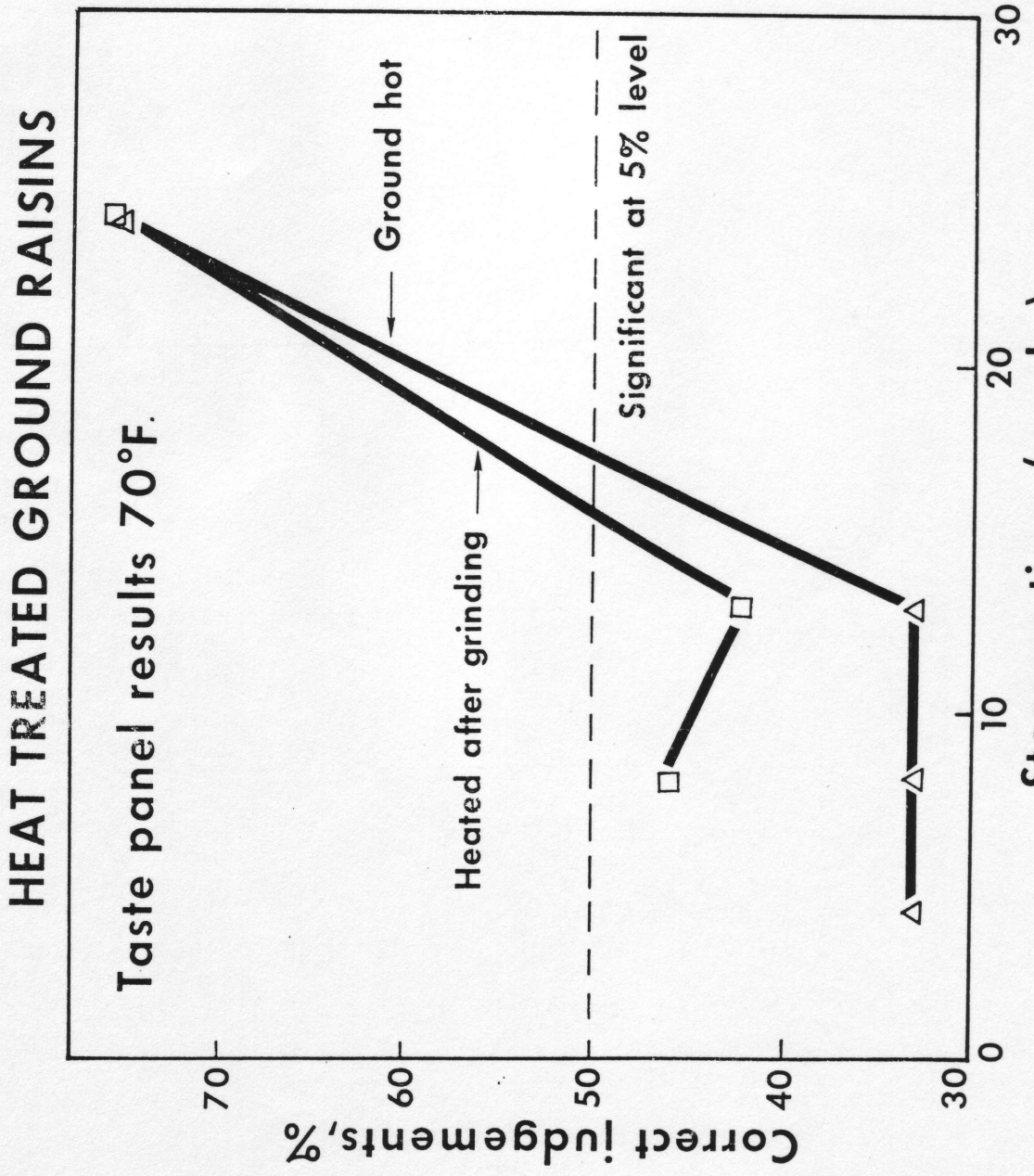

Figure 8 - Flavor difference developed in heat treated ground raisins during storage at 70°F.

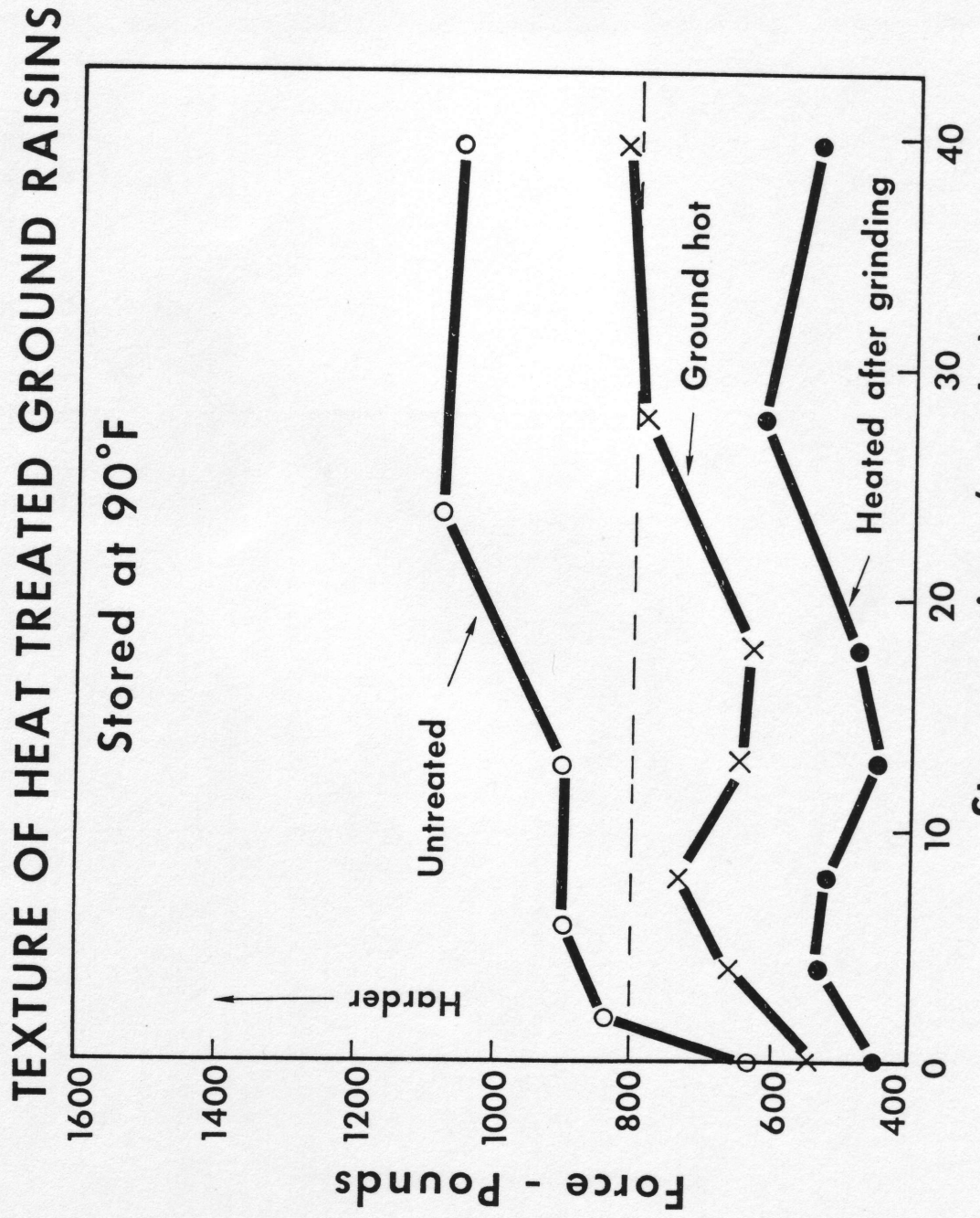

Figure 9 - Hardening of ground raisins when stored at 90°F.

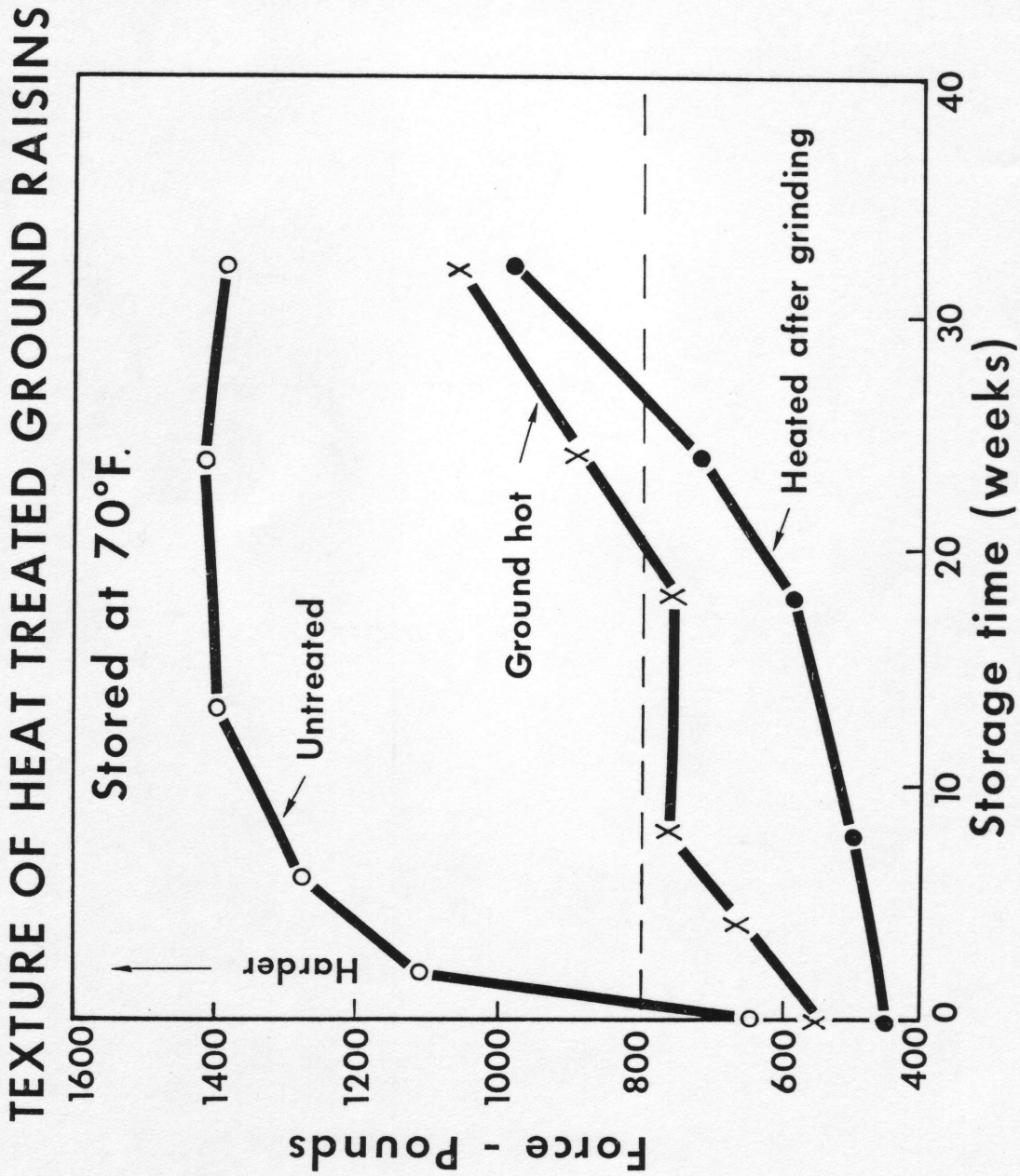

Figure 10 - Hardening of ground raisins when stored at 70°F.

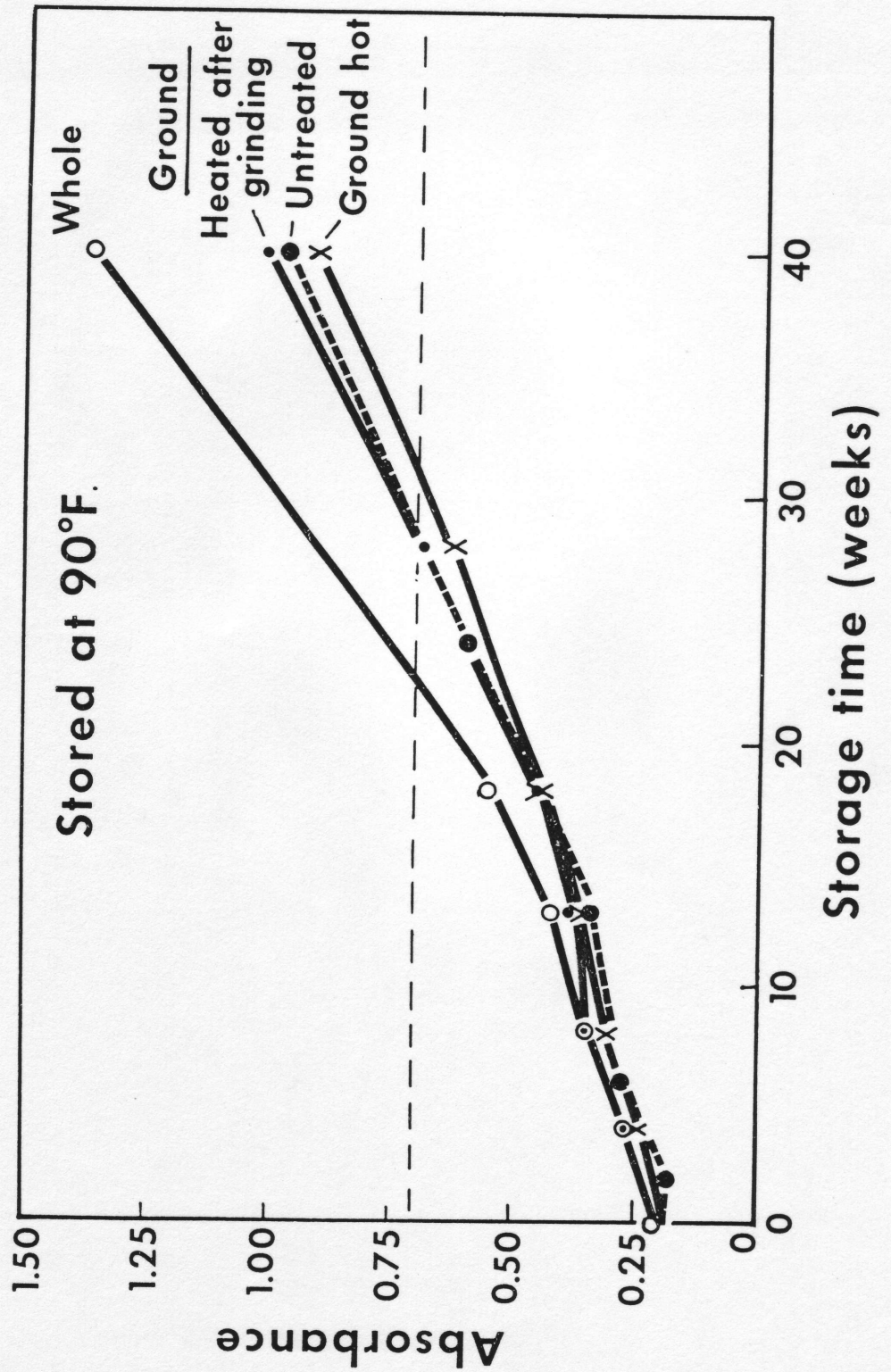

Figure 11 - Alcohol extractable color of ground and whole raisins stored at 90°F.

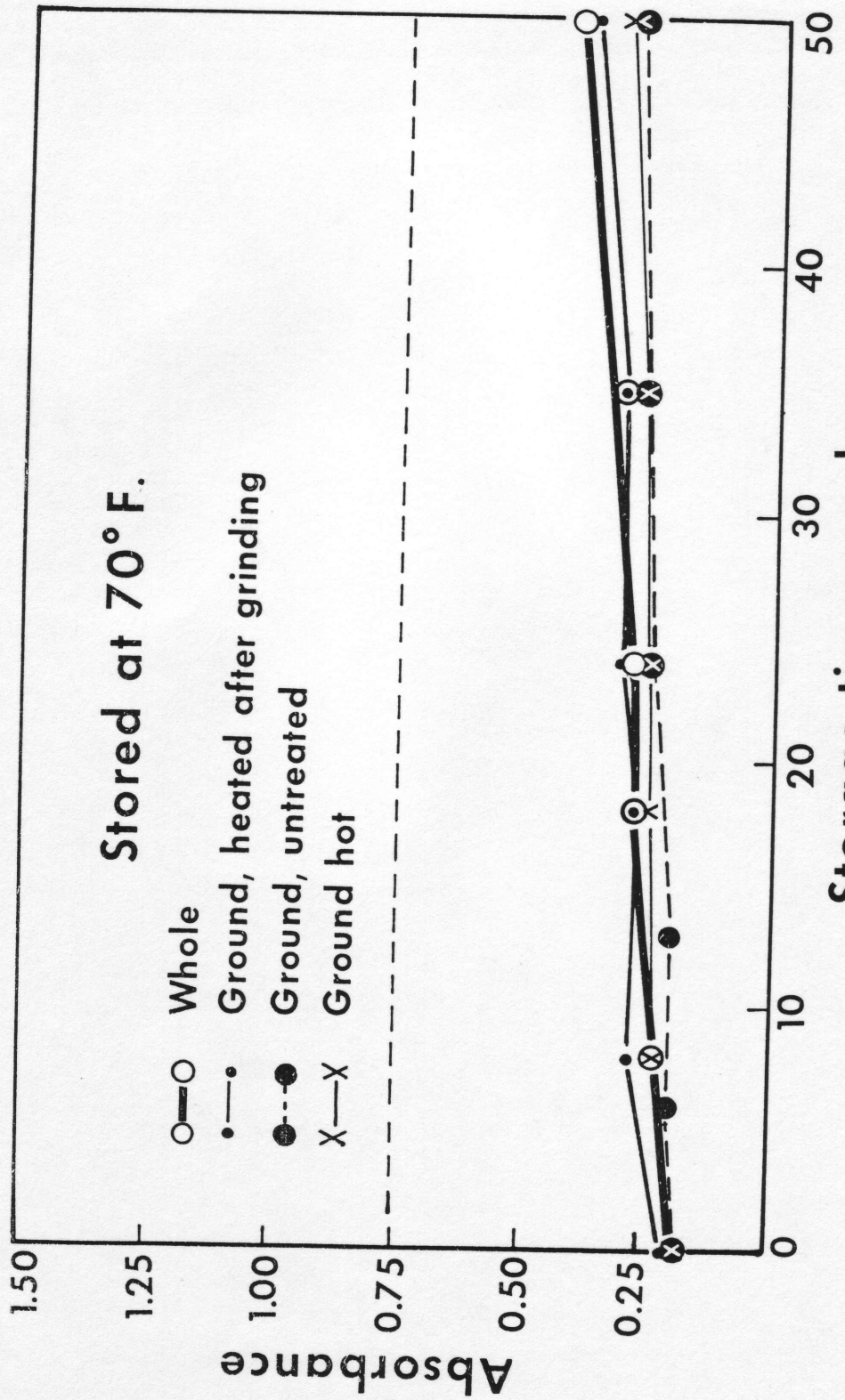

Figure 12 - Alcohol extractable color of ground and whole raisins stored at 70°F.