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RESEARCH ON DISCOLORATION OF CANNED BARTLETT PEARS

1954 SEASON

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During the 1954 canning season several canners of Bartlett pears reported considerable difficulty with browning of the processed product. Only certain lots of pears were susceptible to this trouble, while others could be processed without difficulty.

The browning reported by canners varied from a slight, barely noticeable rose-brown tinge, to a pronounced browning. Also, it was usually found that only some of the halves browned in the can while other halves remained fairly clear. In severe cases, more than half of the number of pieces in the cans would be brown. In less severe cases, one or two were discolored.

Heating important

The Oregon Agricultural Experiment Station conducted studies on this situation in 1954. Tests at the Food Technology canning laboratory showed that the discoloration did not occur in cans closed under vacuum. Tests also showed that a very noticeable and very undesirable browning occurred in cans siruped at temperatures below 165°F. and heat exhausted at temperatures of 182°F. to 192°F. in steam. This tendency was very greatly reduced by any treatment which increased the speed of heating, the most effective measure being the raising of exhaust temperature. It was possible to pack reasonably satisfactory lots of pears from "brown susceptible" lots by these adjustments in sirup temperatures and exhaust temperatures. However, the vacuum packed samples were always best.

### Cause unknown

The cause for this unusual browning tendency is not known although unfavorable weather conditions during the growing season are suspected. Whatever the cause, unusually strong oxidative enzymatic activity in the raw fruit has been demonstrated by chemical tests. This, plus the fact that there was variability in browning among halves of pears within a single can, indicated that raw material rather than processing was a factor in the trouble. Processing technique also became of interest as a possible source of trouble, however, since a canner using heat exhaust was the first to report the difficulty, and the brown condition often could be seen as the cans of pears came out of the exhaust box.

After the preliminary observations, the Oregon Agricultural Experiment Station was asked to work on the problem through its Horticulture and Food Technology Departments. Pears of lots which the canners thought to be susceptible to the trouble, together with pears of lots which had shown normal color, were secured for further studies.

### Enzymes unusually active

It was found that the pears from lots susceptible to browning were more than usually active enzymatically. Susceptible pears treated with catechol, an oxidase substrate, discolored more rapidly than similarly treated nonsusceptible fruit. Thus, attention was directed toward solving the problem by dealing with enzyme activity, and experiments were set up accordingly.

In the first experiments, attempts were made to control the browning by dipping the peeled pear halves in salt solution prior to filling. This did not appear to be helpful. The effects of heating, with peeled pears of both susceptible and nonsusceptible lots being exposed to steam while on stainless steel trays in a small blanching cabinet, were tried.

### Blanching, if long enough, helps

Tests of steam blanches of relatively short periods,  $3\frac{1}{2}$  minutes or less, brought out some differences between pears susceptible to browning and those which were not. About 50 per cent of the susceptible pears subjected to short blanching quickly developed the off-color after cooling. In the nonsusceptible lots, browning did not develop for several minutes. Cutting of the halves showed that the discoloration was under the surface, which appeared to explain the odd, rose-brown tinge which the canners had noted. This also indicated that enzymatic activity had been inhibited in the surface tissues by blanching, but not in the interior tissues. Longer blanches of 7 minutes' duration were then tested, and it was found that both susceptible and nonsusceptible lots did not discolor following this treatment. Further tests showed that it was necessary for blanching to be continuous for the full time to produce a clear color in both types of pears. For example, if the susceptible pears were blanched for 3 minutes and then cooled, the rose-brown color would develop and would remain even though another heat treatment of 3 minutes was applied. In this respect, this discoloration is different from normal surface browning which will ordinarily clear during heat exhausting.

### Sirup temperature a factor

Since the browning reaction was heat sensitive, experiments on the exhaust and sirup temperatures were conducted. Canning under heat exhaust resulted in variable results, depending on the sirup and exhaust box temperatures. The results of an experiment on sirup temperature are shown in Table 1. Here an improvement in color was noted with the higher sirup temperatures. However, the improvement due to higher sirup temperatures was dependent on getting the cans to the exhaust box quickly. Failure to do

this resulted in a broken heating cycle during which discoloration had an opportunity to develop.

High exhaust temperature can also help

Further experiments dealt with exhaust box temperature, using sirup temperatures of 150° F. and 165° F. which had been observed to be associated with poor color. The results of these studies are shown in Table 2. In tests with temperatures of 182° F. and 210° F., the higher temperature produced the clearest product. However, occasionally even under high exhaust temperatures, some pears still showed off-color. Thus, there may be conditions under which high exhaust temperatures and high sirup temperatures might not entirely correct the trouble.

"Cool" sirup plus vacuumizing is good if retorting is prompt

The best and clearest pears were produced by the use of "cool" sirup (below 130° F.) and sealing under vacuum. This test was repeated several times with equally good results. By the use of this process -- cool sirup, vacuum sealing, immediate retorting -- fast heating was accomplished with no opportunity for the development of discoloration.

Further work on pears showed that this color could be produced on susceptible lots of pears by the use of a sirup temperature lower than 165° F. combined with an exhaust temperature lower than 192° F. Substantial improvement was usually obtained with a higher sirup temperature-exhaust temperature. The trouble was never encountered when vacuum closing was used, probably, as indicated above, because the heating, once begun, was continuous and because the amount of air in the can was reduced.

Enzymes may be reason for browning

Although the cause for browning of pears during the canning procedures, as encountered in 1954, is not known, the occurrence of browning can best

be explained as due to an unusually active enzyme in certain pears.

Results of experiments strongly suggest this.

Because enzymes usually are quite inactive at lower temperatures and are destroyed at higher temperatures, but are most active at about 110°F., the control of browning during processing should be accomplished by getting the pears through the active zone of temperatures as quickly as possible. If the enzyme is destroyed quickly and completely by bringing the pears to a high temperature rapidly, it will not have time to react and cause browning.

### Conclusions

Although the studies reported here are not conclusive, they do strongly suggest how the browning of pears, as occurred in 1954, might be prevented if it is encountered again. The best solution known is to keep the pears relatively cool until exhausting or retorting is started. Once the heating is started, keep the temperature rising fast until the pears are heated above the point where the browning can occur.

Table 1. The Effect of Sirup Temperature on Color of Pears Susceptible to Browning When Exhausted in Steam at 210°F. for 7 Minutes.

Lot	Sirup temperature <sup>1/</sup> Degrees F.	Gauge vacuum Inches	Ranking of colors of product after canning
A	206°	20	Second
B	186°	19	Third
C	166°	18	Fifth (Poorest)
D	149°	17	Fifth (Poorest)
E	126°	12	Fourth (Poor)
F	116°, but closed by vacuum sealer	13	First (Best)

<sup>1/</sup> When applied to pears in the can.

Table 2. The Effect of Exhaust Box Temperature on Color of Pears Susceptible to Browning (Exhaust Time 7 Minutes).

Lot	Sirup temperature <sup>1/</sup> Degrees F.	Exhaust box temperature Degrees F.	Gauge vacuum Inches	Ranking of color of product after canning
A	150°	182°	11	Fourth (Badly discolored)
B	165°	182°	12	Fourth (Badly discolored)
C	150°	192°	14	Third (Discolored)
D	165°	192°	14	Third (Discolored)
E	150°	210°	19	Second
F	165°	210°	18	Second
G	128°, but closed by vacuum sealer	-	18	First (Best)

<sup>1/</sup> When applied to pears in the can.