

## AVOCADO BY-PRODUCTS

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At the present time, there does not seem to be any very great need of a by-product industry to utilize waste avocados. Still there is a certain amount of soft fruit and blemished fruit which normally will find no market in the fresh condition. In order to develop practical methods of utilizing this fruit and any contemplated over production, experiments have been carried on in the Zymology Laboratory during the past two years.

**Avocado Paste:** Since the fruit is used as a salad fruit, the first thought will be to prepare a paste or minced product from the peeled fruit and preserve it by suitable methods. This idea was tested very thoroughly. Paste was treated with varying amounts of salt to preserve it without sterilization. Portions of the same lots were sterilized at various temperatures. Various antiseptics were tried, such as vinegar, or benzoic acid. Fermentation of the paste before canning was also experimented upon.

In all cases, the results were poor because of the loss of the fresh avocado flavor and the development of an acrid taste.

It is possible that if the fruit was treated with lye before making into a paste, the acrid taste would be eliminated. Experiments made on the peeled halves would indicate this to be true.

**Dried Avocados:** Peeled and pitted fruit was dried at 100 degrees C. The flavor of the dried product was palatable, but very much inferior to the fresh article. Used in soup, it was found to impart a pleasant rich flavor. It seems to have possibilities as a flavoring for high-priced soups. The temperature of drying used should not be above 212 degrees F. The flesh darkens during drying.

**Canning Avocados:** A number of different lots of fruit were canned in various kinds of brines and syrups and at various temperatures. Salt brines were unsatisfactory in all cases. A disagreeable acrid taste develops in the fruit canned in plain water or brines of various degrees of salt.

Fruit canned in a 60 per cent cane sugar syrup at 180 degrees F gave excellent results. The flavor was rich and seemed equal to that of the fresh fruit. The only objection seems to be that the flavor is a little too rich for the product to be eaten freely. Fruit sterilized in a syrup at 212 degrees F. was not equal to that sterilized at 180 degrees F. The addition of a small amount of lemon juice to the syrup improved the flavor of the canned product.

Syrups of lower concentration than 60 per cent were not so satisfactory as the heavy syrup.

**Preservation in Vinegar and in Brandy:** The fruit keeps well if stored in ordinary cider vinegar, but the excess vinegar must be leached out before using the fruit. This flattens the flavor considerably, but the product is fairly palatable. The texture becomes soft on long standing.

When stored in brandy of good quality the halved fruit retains its color, texture and flavor very well. The alcohol is easily removed by soaking the fruit in water twenty-four hours before use.

**Oil:** As Professor Jaffa has pointed out in a paper presented last year, the avocado is very rich in oil which constitutes a very large portion of the nutritive value of the fruit. It is probable that it will be many years before enough avocados are produced in the state to make possible the establishment of an avocado oil industry. As a point of interest, however, various methods of recovering the oil were tried out on a very small scale. It seemed to be necessary to dry the fruit first. The oil was then recovered by pressure at 500 pounds per square inch and the oil left in the press cake was extracted with ether. The oil obtained by pressure had a pleasing flavor. Its appearance was greatly improved by decolorizing with bone-black and filtration. A great deal of solid fat separates on cooling the oil. This can be removed by filtration. The oil at best was inferior to good cottonseed oil. Therefore, avocado oil as a by-product does not seem very promising for table use. It may later be discovered to have other uses, such as in soap-making.

The following table gives a summary of the more important experiments performed.

**Summary:** Avocados canned in a 60 per cent syrup at 180 degrees F. retained more of the fresh rich avocado flavor than did products prepared in any other way. This seems to be one of the most promising avocado by-products. Canning in brine or plain water gave poor results. Avocados treated with 3 per cent lye for 24 hours in the same way that olives are pickled gave a very palatable product, after removal of lye and sterilization in a dilute brine. Avocado pastes were in all cases unsatisfactory. The flavor of the fruit was fairly successfully retained by pickling the halves in vinegar or in brandy. Dried avocados gave a very pleasing flavor to vegetable soup. The oil is not satisfactory as a food.

In general, the canning in heavy syrups seems to be the most satisfactory method of preserving avocados or avocado products.

### **Discussion**

**Mr. Taft:** Your investigations as reported were confined almost entirely to the thin-skinned varieties. Have you investigated the thick-skinned varieties also?

**Prof. Cruess:** Our investigations have been confined to the thin-skinned varieties principally and seedlings of thin-skinned types sent up by Mr. Taft. The material worked with was not first class. It was soft fruit in most cases.

**Mr. Taft:** It is possible that when you investigate the larger varieties you may be able to succeed better.

**Prof. Cruess:** One of the troubles is that the fruit softens.

Experiment Number	Date Treated	Date Examined	TREATMENT	RESULTS
1803-a	1915 Nov. 23	1915 Nov. 25	Dried at 212 deg. F.	Made good soup flavoring. Not satisfactory for eating alone.
-b	" 23	" 25	Dried and pressed. Pomace extracted with ether. Press oil decolorized and filtered.	Press oil edible. Solvent oil poor.
-c	" 23	Dec. 5	Halves treated with ½ % lye 24 hours. Lye washed out with water. Sterilized in 5% brine.	Fermented slightly during lye treatment. Flavor poor.
-d	" 23	" 5	Same as 1803-c, but 1% lye used.	Same results as 1803-c.
-e	" 23	" 5	Same as 1803-c, but 3% lye used.	Flavor excellent. Texture a little too soft.
-f	" 23	" 5	Same as 1803-c, but 5% sodium carbonate used.	Results fair. Not so good as "e".
-g	" 23	" 5	Canned halves in plain water at 85 deg. C.	Acrid taste. Not satisfactory.
-h	" 23	" 5	Canned halves in 3% brine at 85 deg. C.	Acrid taste. Not satisfactory.
-i	" 23	" 5	Canned halves in brine plus vinegar to increase acid to .3%.	Not satisfactory.
-j	" 23	1916 Feb. 1	Pickled in vinegar.	Flavor good if excess vinegar is washed out.
-k	" 23	" 1	Pickled in brandy.	Flavor good if excess alcohol is washed out.
1803-l	" 23	1915 Dec. 5	Paste from boiled fruit sterilized at 212 deg. F.	Flavor very poor.
-m(1)	" 23	" 5	Paste plus 1% salt, not sterilized.	Flavor very poor; color, dark.
-m(2)	" 23	" 5	Paste, plus 3% salt, not sterilized.	Flavor very poor; color dark.
-m(3)	" 23	" 5	Paste plus 6% salt, not sterilized.	Flavor very poor; color dark.
-m(4)	" 25	" 5	Paste plus 12% salt, not sterilized.	Flavor poor.
-m(5)	" 25	" 5	Paste plus 15% salt, not sterilized.	Flavor poor.
1803-n(1) to-n(4)	" 25	" 5	Salt, varying from 1 to 15%, followed by sterilization at 100 deg. C.	Flavor poor in all cases.

1835 (1)	1916 Jan. 26	1916 Mar. 15	Peeled halves in plain water. Sterilized at 212 deg. F.	Flavor acrid and disagreeable.
1835 (2)	" 26	" 15	Peeled avocados in 30% syrup; sterilized at 212 deg. F.	Fair. Not so good as (3).
1835 (3)	" 26	" 15	Peeled avocados in 60% syrup; sterilized at 212 deg. F.	Palatable. Flavor very rich. Not so good as (4).
1835 (4)	" 26	" 15	Peeled avocados in 60% syrup; sterilized at 180 deg. F.	Flavor excellent, but very rich.
1835 (5)	" 26	" 15	Peeled avocados in 60% syrup plus 3% lemon juice. Sterilized at 180 deg. F.	Best of series; flavor very rich.