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**The preparation of**

**FULL-FLAVOR**

**BERRY JUICE**

**CONCENTRATES**

**Agricultural Research Service**

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## ABSTRACT

Berry juice concentrates, possessing characteristic fruit flavor, have been prepared by methods adaptable to continuous, commercial operation.

Blackberry, blueberry, red raspberry, and strawberry juices were studied to determine suitable processing conditions. Highly satisfactory full-flavor concentrates were made by employing either an essence recovery and a separate juice concentration process or a simultaneous essence recovery and juice concentration process.

The methods employed for the preparation of each berry concentrate are given.

This is a report of work done at the  
EASTERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION  
Philadelphia 18, Pa.

# THE PREPARATION OF FULL-FLAVOR BERRY JUICE CONCENTRATES

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## INTRODUCTION

The process for the recovery of volatile fruit aromas in concentrated form, originally developed by the Eastern Utilization Research and Development Division for apple (14, 15, 9, 10)\* and Concord grape (8, 11), has been successfully adapted to large-scale commercial installations (16, 2, 17). This technique enables concentrated fruit products to possess the characteristic, true fruit aromas that were formerly lost during processing. Additional research work conducted at both the Eastern Utilization Research and Development Division and the Western Utilization Research and Development Division on apple (13, 23), pear (27), cherry (1), prune (24), peach (6), and strawberry (25) full-flavor concentrates has further demonstrated the applicability of these principles.

Utilization of low-bulk, full-flavor concentrates by the food processing industry has been steadily increasing, particularly in the preparation of jellies. The West Coast is the largest berry producing area in the United States, and this provided incentive for early commercial production of these concentrates in that region. Eastern jelly manufacturers, however, had to rely on a distant source of supply. Therefore, development of good quality Eastern berry concentrates would substantially benefit these processors as well as provide additional market outlets for growers in this area.

The purpose of this publication is to present the work done at the Eastern Utilization Research and Development Division on the preparation of full-flavor blackberry, blueberry, red raspberry, and strawberry concentrates.

## GENERAL PROCESSES

Figure 1 shows a flow sheet of the volatile flavor (essence) recovery and separate-juice concentration process. Briefly, the process consists of pumping the expressed berry juice to an essence recovery apparatus, in which the juice is stripped and the aromas are concentrated. The stripped juice is concentrated by vacuum evaporation with or without prior depectinization depending upon the degree of concentration desired. Articles on the design and operation of conventional essence recovery units have been published (3, 18, 4, 20, 26, 5).

Figure 2 illustrates the simultaneous essence recovery and juice concentration process. The amount of juice vaporized in an essence recovery unit in this process is usually greater than that required for adequate stripping of aromas. This is necessary in order that desired juice concentration will be achieved in a single pass. The process eliminates the need for a vacuum evaporator. Details of this process have been described (7-12)

\* NUMBERS IN PARENTHESES REFER TO LITERATURE CITED AT END OF REPORT.

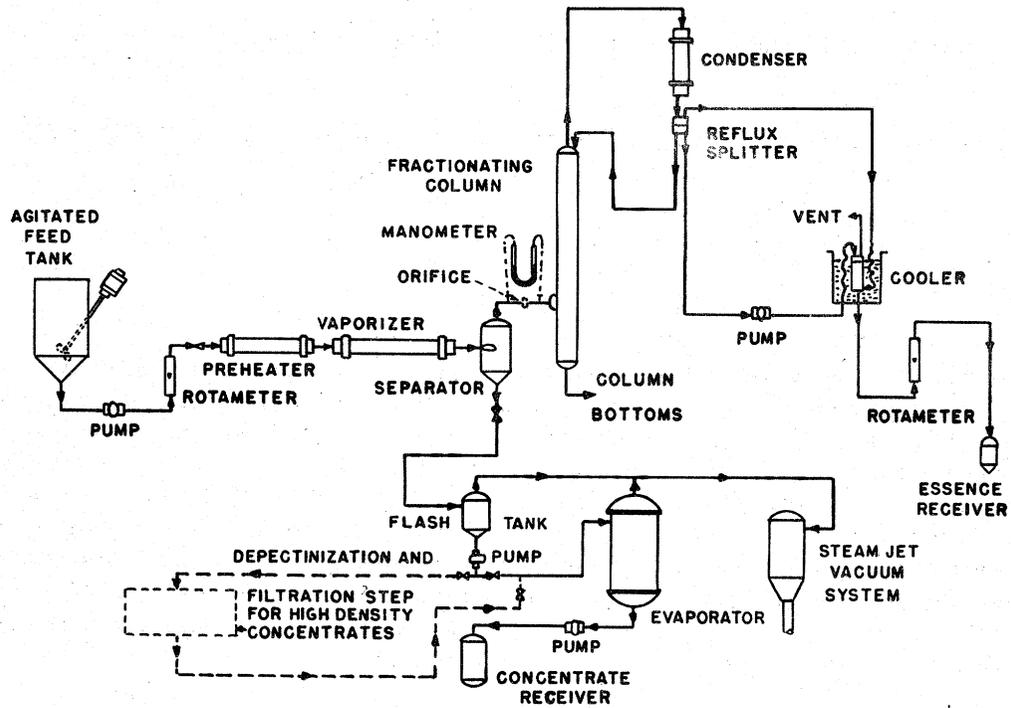


FIGURE I  
Process of essence recovery and separate juice concentration.

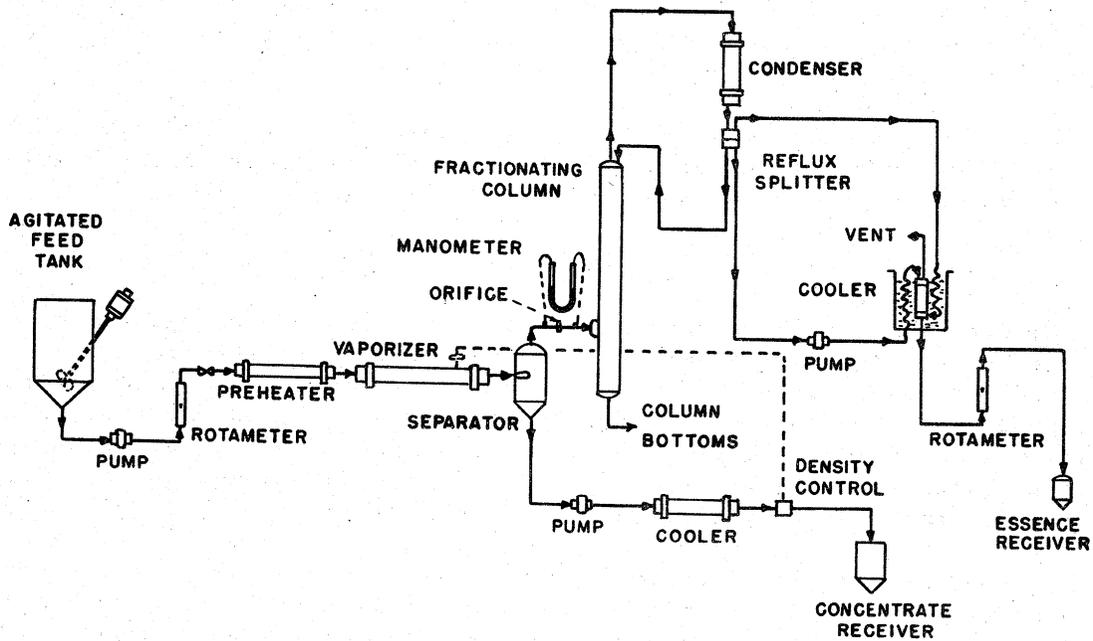


FIGURE 2  
Process of simultaneous essence recovery and juice concentration.

## DETAILS OF OPERATIONS

A satisfactory product can be made only from sound, mature berries suitably processed into juice to prevent flavor impairment. Juice preparation, except for blueberry, is not covered in this publication. Conventional methods can be found in the literature (21). Processing of the juice should be rapid to avoid fermentation so that the essences will not have an excessive ethyl alcohol content (22).

Preparation of the full-flavor concentrates was as follows:

Blackberry: The process, shown essentially in Figure 1, consisted of vaporizing 40% by volume of Black Diamond variety juice in an essence recovery unit and concentrating the evolved aromas to a 150-fold essence. (This essence fold, e.g., 150 times the aroma concentration in single strength juice, will result in only minimal dilution of the concentrated juice when restored.) The stripped juice was depectinized with 2.3 ounces of Rohm and Haas Pectinol 10M.\* per 100 gallons for 3 hours at 100° F. The depectinized juice, with added filter aid (diatomaceous earth), was filtered in a conventional plate and frame filter press previously precoated with filter aid. The sparkling clear filtrate was vacuum evaporated at a batch temperature of 110-115° to a high density concentrate of 72° Brix.

Another method used successfully was the simultaneous essence recovery and juice concentration process shown in Figure 2. Juice was first depectinized and filtered, then 91% by volume was vaporized to produce 72° Brix concentrate and 150-fold essence.

Triangle type taste tests were used to compare the reconstituted full-flavor concentrates, prepared by both methods, with the starting juice. A significant difference on a 5% level of probability was not established in either case.

Whether or not the essence is to be restored to the stripped juice concentrate depends upon the intended use. For flavoring candies, ice cream or for beverage use, the essence should be returned to the concentrate. In preparing jelly from concentrate a "short boil" (21) is normally used, and although little or no evaporation may take place a significant loss of restored aromas may occur. Therefore, essence should be returned at the last phase of processing such as the filling operation. A new process for jelly manufacture in which full-flavor concentrates are used has been described by the Western Utilization Research and Development Division (19).

Blueberry: Full-flavor, high-density concentrates of 69° Brix were prepared from both cultivated and wild blueberries.

Blueberry color and flavor can be intensified, similarly to that of Concord grape, by heat processing the raw berries prior to expressing the juice. The berries were heated batchwise to 180° F., then cooled with continuous agitation.

Twenty-five minutes were required to raise the temperature from 55° to 180°, and 30 minutes to cool to 100°. The heat treated berries were depectinized with 2.3 ounces of Rohm and Haas Pectinol 10M. per 100 gallons, for 3 hours at 100°. Juice was expressed from the depectinized slurry in a conventional rack and cloth cider press without need of pressing aids, such as diatomaceous earth. A juice yield of 85% by weight of press feed was obtained. A polishing filtration with a plate and frame filter press was needed to produce a sparkling clear juice.

Since the vaporization required for aroma recovery was as high as 50% by volume, the simultaneous essence recovery and juice concentration process was used. This required 88% vaporization by volume to produce a 72° Brix concentrate, or a full-flavor concentrate of 69° Brix with restored 150-fold essence. Full-flavor concentrates prepared from cultivated and wild blueberries were found to be equal in flavoring potency and of the same character. An excellent topping for ice cream has been made from the full-flavor concentrates.

The preliminary work on wild blueberries was done in cooperation with the Maine Development Commission and the Maine Agricultural Experiment Station.

Red Raspberry: Full-flavor, high-density concentrates of 69° Brix were prepared from the juices of Columbian and Newburgh varieties. In each case 40% vaporization by volume was required to strip the aromas in an essence recovery unit. The stripped juice was depectinized and filtered, as was done with blackberry juice. The juice filtrate was then vacuum evaporated at a batch temperature not exceeding 100° F. to 72° Brix so that the full-flavor concentrate with restored 150-fold essence would be 69° Brix.

Taste panel evaluation of the reconstituted full-flavor concentrates compared with their respective starting juices showed no significant difference on a 5% level of probability.

Strawberry: Juices from the Eastern varieties, Premier and Blakemore, were processed to medium (50° Brix) and high-density (70° Brix) full-flavor concentrates.

Since gel formation can occur in the single strength juices of both varieties, it is important that depectinization precede further processing. This can be accomplished while expressing the juice, and has the additional advantage of increasing the juice yield.

Juices from both varieties were processed in the conventional manner. A 20% vaporization by volume was required to strip the aromas from the depectinized and filtered juices. The stripped juices were then vacuum evaporated at a batch temperature not exceeding 100° F. to 51.9° Brix for medium density concentrate and 74.2° Brix for high density concentrate. Restoration of 150-fold essence yielded respectively 50° Brix and 70° Brix full-flavor concentrates.

The reconstituted full-flavor concentrates of the Premier variety were indistinguishable in flavor and color from the starting juice. However, the color of the full-flavor Blakemore concentrates was darker than the starting juice and they possessed a slight heat-treated flavor.

A modified technique was necessary to prepare Blakemore concentrates comparable to the starting juice. The method consisted of vacuum concentrating the depectinized and filtered juice at 100° F. and then recovering essence from the distillate at 20% vaporization by volume in a conventional unit. However, Blakemore concentrates prepared in the conventional manner would undoubtedly be satisfactory for most applications.

Medium density full-flavor concentrates (49.4° Brix) of Marshall variety strawberries were prepared by three processing methods. These were (1) vacuum juice concentration followed by essence recovery from the distillate, (2) essence recovery from juice (20% vaporization) followed by vacuum concentration of the stripped juice, and (3) simultaneous essence recovery and juice concentration (82.5% vaporization). The resultant full-flavor concentrates were of comparable quality. The reconstituted full-flavor concentrates, on comparison with single strength juice, showed that only a slight difference in color and flavor resulted from processing.

#### STORAGE

It is recommended that berry concentrates and essences be kept in frozen storage for maximum retention of color and flavor.

#### SUMMARY

The advantages of concentrated fruit juices are evidenced by their increased utilization for beverages and in food processing. This publication has described methods of preparing concentrates from blackberries, blueberries, red raspberries, and strawberries possessing full, characteristic, true fruit aroma.

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