# Simple Technique for Extracting Flavor Compounds from Fatty Foods

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**Abstract**

A method for extracting flavor compounds from cheese with acetonitrile is described. Two of the unique advantages of the method are that it does not extract fat and the first few drops of the extract are sufficiently concentrated to permit gas-chromatographic analysis without solvent evaporation. The effectiveness of extraction is demonstrated on Cheddar cheese, Blue cheese, and heated milk fat. The recovery efficiency is exemplified by 103% recovery of added benzoic acid.

In the investigation of food flavors, the researcher is often confronted with the problems of isolation and concentration of the flavor essence. Essentially, there are two isolation techniques available to the investigator, solvent extraction and distillation (1). The poor recovery of the less volatile compounds by distillation limits its use, particularly since these compounds are being implicated more and more frequently in the significance of flavors. The disadvantages of solvent extraction are formation of emulsions in aqueous systems, extraction of lipids in fat-containing foods, and loss of low-boiling compounds during removal of the solvent.

In our investigation of Cheddar cheese flavor, we have developed a simple solvent extraction technique which minimizes these disadvantages. Acetonitrile, when used to extract Cheddar cheese, yields a concentrated extract which typically is very cheesy and virtually free of fat. The extraction of polar compounds by acetonitrile may account for a segment of Cheddar aroma which is overlooked when the cheese fat alone is investigated.

Twenty grams of Cheddar cheese which has been finely shredded in a hand grater is ground with 25 g of Celite 545 in a mortar. The resulting homogeneous mass is packed dry into a 1.6- by 40-cm chromatographic column in 15-g portions with moderate tamping. The column is then eluted with 50 ml of redistilled acetonitrile. Most of the compounds recovered from Cheddar cheese will be eluted with 50 ml of solvent, depending upon how effectively the column has been packed. Typically, the first few drops of solvent will be more highly concentrated and, in fact, sufficiently concentrated to be gas chromatographed directly without further evaporation. The odor of a drop of this extract when rubbed on the back of the hand is usually described as Cheddar-like or very cheesy. Small amounts of the concentrated extract when added to minced, bland cheese impart a Cheddar flavor.

The effectiveness of this extraction is demonstrated by Fig. 1. Fig. 1 is a gas chromatogram obtained by injecting 5 $\mu$l of the first ml of acetonitrile eluate of 20 g of Cheddar cheese. Acetonitrile extracts from the cheese only trace quantities of fat and water which do not interfere with subsequent gas-chromatographic analysis. For qualitative investigations, the acetonitrile extract can be analyzed directly, extracted with petroleum ether from which the solvent can be removed more easily, or evap-

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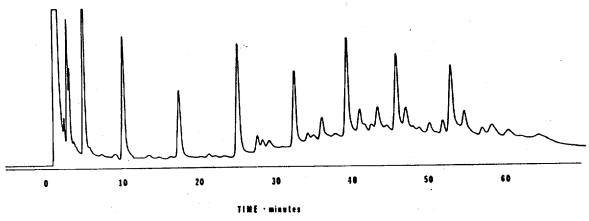


FIG. 1. Gas chromatogram of acetonitrile extract of Cheddar cheese (5 $\mu$l of first milliliter collected). Chromatographic column 1/4 in. by 6 ft, 7.5% EGA + 2% $H_3PO_4$ on 70-80 mesh Anakrom ABS. Temperature program 85 to 180 C at 2 degrees/minute.

orated carefully to a small volume and extracted with ethyl ether.

To ensure complete extraction, larger volumes of acetonitrile may be necessary to elute the column. To determine the extent of recovery, benzoic acid was added to a cheese-celite mixture before packing into a column. The column was eluted with 100 ml of acetonitrile, evaporated to 8 ml, and gas chromatographed. Fig. 2 shows the gas chromatogram obtained of the benzoic acid peak representing 2.06 $\mu$g. Compared to the peak of a benzoic acid standard of 2.14 $\mu$g, the recovery was 103%.

This extraction procedure has been used on other dairy products with varying degrees of success. Blue cheese and a heated milk fat which has an intense buttery flavor are very successfully extracted (Fig. 3 and 4).

The merits of this technique which enhance its value as an extraction procedure are: 1) It is effective for removing flavor compounds; 2) it is quick and simple, requiring a minimum of apparatus; 3) it extracts only trace quantities of fat and water; 4) in most cases, evaporation of solvent is unnecessary; and 5) acetonitrile is a good solvent for both polar and nonpolar compounds. We believe the method will find its greatest utility in the extraction of such dairy products as cheese, butter, and milk fat. It may also prove applicable to the investigation of specific compounds or classes of compounds of interest which can be selectively removed from the acetonitrile extract.

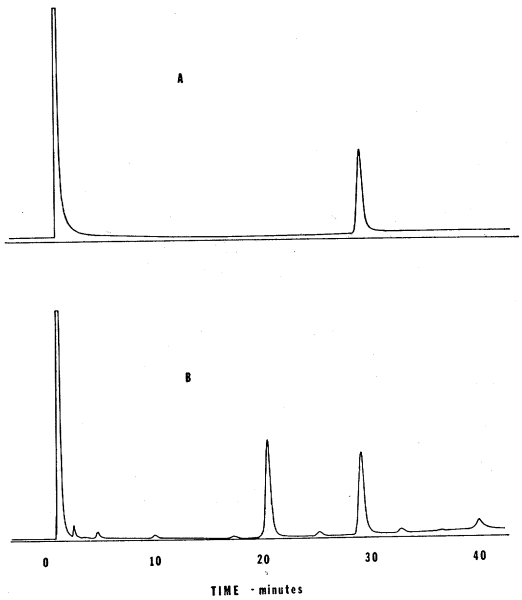


FIG. 2. Gas chromatogram of standard benzoic acid (A) and standard recovered acid (B). The peak at 21 min in Chromatogram B is tentatively identified as sorbic acid which has been added to cheese as a mold inhibitor.

## Reference

(1) Hewitt, E. J., D. A. M. MacKay, and S. A. Lewin. 1958. Physicochemical approaches to the study of flavor. *In* Flavor Research and Food Acceptance. Arthur D. Little, Inc., Reinhold Publ. Corp., New York.

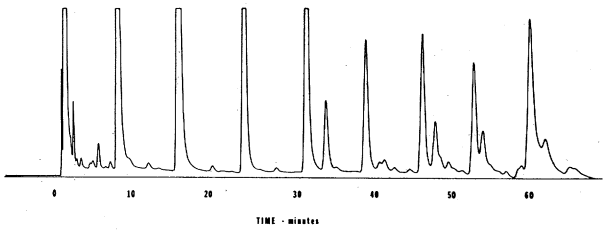


FIG. 3. Gas chromatogram of acetonitrile extract of Blue cheese.

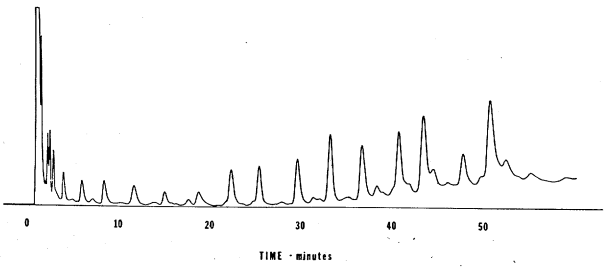


FIG. 4. Gas chromatogram of acetonitrile extract of heated milk fat.