Researchers use capillary electrophoresis to examine effects of processing and storage variables on buttermilk

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Introduction

This project focused on defining and understanding the correlation between metabolically important organic acids and sensory characteristics of buttermilk. Biological and processing parameters influence these characteristics and were studied from the point of view of organic acid changes in buttermilk and cream. Using descriptive analysis and capillary electrophoretic measurements of different organic acids as indicators of biological or microbial degradation, we examined the effects of processing and storage variables on buttermilk samples manufactured at Cal Poly San Luis Obispo and those collected from industrial sources. This information is necessary for improvement of quality control and for increasing the value of buttermilk.

The first step of the research was to develop a lexicon describing the sensory attributes of buttermilk. The lexicon was developed by a panel of judges at University of California, Davis. We then developed and assessed instrumental measurements of the organic acids by capillary electrophoresis. The processing and storage treatments were studied to determine their effects on the quality of buttermilk.
A capillary electrophoresis (EC) method for the simultaneous separation of 11 metabolically important organic acids (oxalic, formic, citric, succinic, orotic, uric, acetic, pyruvic, propionic, lactic and butyric), 10 amino acids (Asp, Glu, Tyr, Gly, Ala, Ser, Leu, Phe, Lys, Trp) and lactose was optimized, validated and tested in dairy products. Repeatability (RSD<5 percent) and linearity (R2>0.99) were calculated for each compound, with detection limit values as low as 0.2×10⁻² mM for citric acid and Gly. The method was applied to analyze yogurt and different varieties of commercial cheeses. This method yielded specific CE patterns for different varieties of cheese. Also, it has been shown to be sensitive enough to measure small changes in composition of some of those compounds in fresh cheese stored under accelerated ripening conditions for two days at 32°C (e.g., from 1728.3 ± 45.0 to 1166.7 ± 4.5 mg/100g DM in the case of lactose, or from 23.5 ± 0.6 to 76.8 ± 16.7 mg/100g DM in the case of acetic acid). This work has been published in peer reviewed papers:


Major Accomplishments

A CE procedure was optimized and found to be well-suited for the simultaneous analysis of lactose, the 11 metabolically important organic acids and the 10 amino acids mentioned. CE has been shown to achieve adequate separations, and the suitability of the technique has been verified by the analysis of linearity and precision.

The published method is an alternative to other analytical techniques, with the additional advantages of low solvent consumption (milliliters per day vs. liters per day for HPLC), short time of analysis, no hazardous solvents, and low costs as compared with others (more than 1000 analyses were run with the same capillary without loss of resolution; in the case of HPLC, columns must be deeply cleaned and regenerated after a few analyses). Nevertheless, the principal advantage is that the great versatility of the method allows analysis of all those compounds simultaneously in the same run, whereas to analyze them by HPLC, different columns, buffers and chromatographic systems are necessary. The procedure offers faster and more simple sample preparation for the analysis (e.g., HPLC analysis of amino acids requires precipitation of the protein and pre- or post-column derivatization of the previously extracted free amino acids to detect them).

Current procedures as sophisticated as MS and MS/MS for the identification of compounds can be adapted to CE using the published procedures.

Impact Statements

♦ This process has enhanced the arsenal of techniques used for food analysis.

♦ Published methods are being referenced in current work, providing dissemination of our techniques.

♦ Presentations at national and international conferences have enhanced scientific communication among our peers.

♦ Industry awareness of these techniques has been demonstrated by the industry employing Cal Poly students to work with CE and dairy products.
**Dissemination**

**Presentations**


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**For More Information**

This research report contains summarized results of Rafael Jiménez-Flores’ study entitled “Organic Acid Determination by Capillary Electrophoresis as Quality Parameter of Buttermilk,” ARI Project No. 02-3-028. (Research Focus Area: Food Science). To view and/or obtain a copy of the complete final report, or to obtain additional information about this or other research projects, visit the ARI website at [ari.calstate.edu](http://ari.calstate.edu). For information on projects specific to Cal Poly San Luis Obispo, visit the Cal Poly ARI website at [ari.calpoly.edu](http://ari.calpoly.edu).

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