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The Development of Quantitative Real-Time Detection of Flavors During Fermentation by Fused-Droplet Electrospray Ionization (FD-ESI) Mass Spectrometry

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Abstract

Fermented dairy products are popular and nutritious foods due to the probiotics (lactic acid bacteria). The flavor produced during fermented milk products becomes an important topic for analytical chemists because they affect the tastes. Usually, fermentation procedure is monitored by the change of pH and the flavor analysis is usually performed by GC or GC/MS. Since these instruments only detect nonpolar compound, some details of the flavor ingredient are not available. Herein, by using a FD-ESI source, we have developed a method for real-time quantitative detection of the flavor during fermentation. The measured targets are lactic acid and acetic acid which are major components of the flavor and always make dramatic change of pH during the fermentation of milk.

Ionization of the analyte in a FD-ESI source was achieved by reacting the gaseous analyte molecules with the charged solvent species generated by electrospray. The pure methanol was used for electrospray. A small amount of trifluoroacetic acid (10^{-9} M) was added into the ES solution as internal standard. The calibration curves were constructed by plotting the ratio of the lactic acid and acetic acid ion signals to the trifluoroacetic acid ion signal (peak height) versus the acid concentrations. Quantification of lactic acid and acetic acid in real sample (fermentation of milk) were then performed by this external standard method.

There are three experimental parameters needed to be properly adjusted when using the FD-ESI to quantify the gaseous lactic and acetic acids: (1) relative position of the exit of the sample tube to the ES capillary tip; (2) flow rate of the nitrogen carrier gas; and (3) flow rate of the electrospray solution. The experimental results showed that the strongest ion signal would be obtained as the angle between the ES capillary and the sample tube is 60 degree and the distance between each other was 0.5-1.0 mm. The best distance between the ES capillary tip to the inlet of the ion trap mass analyzer was found to be approximately 3.0~5.0 mm. The optimal condition was obtained when the flow rates of ES solution and nitrogen carrier gas were 2.5 uL/min and 400 c.c./min, respectively.

Key words: FD-ESI, Quantitative, Fermentation