Determination of Biogenic Amines in Spoiled Cheese by Ion Chromatography with Integrated Pulsed Amperometric Detection

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Biogenic amines can be formed in foods from the decarboxylation of amino acids, by enzymatic reactions, or by the amination of corresponding aldehydes (1). The consumption of food containing high concentrations of biogenic amines, such as histamine and tyramine, can have toxicological effects resulting in nausea, headaches, respiratory distress, oral burning, and hyper- or hypotension among other symptoms (2). In cheese, the amino acid tyrosine (precursor to tyramine) is present at high concentrations. Tyramine causes the release of noradrenaline from the nervous system and can therefore result in high blood pressure, severe headaches, and possible brain hemorrhage or heart failure (3). In this paper, we compare the concentration of biogenic amines in fresh and spoiled cheese using ion chromatography (IC) with integrated pulsed amperometric detection (IPAD).

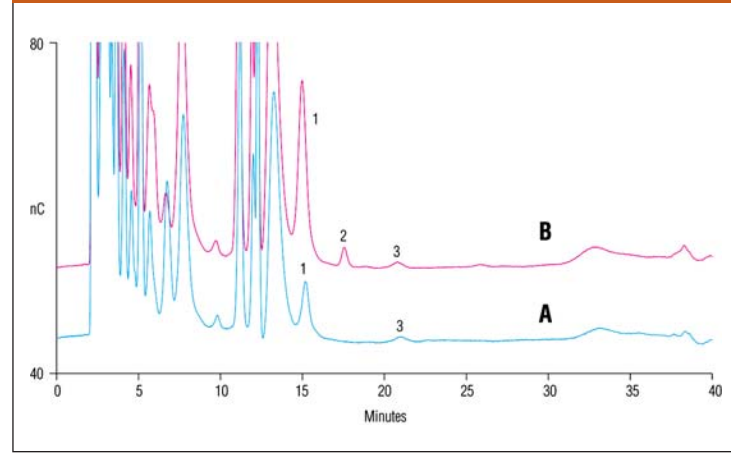

Figure 1: Determination of biogenic amines in A) fresh and B) spoiled cheddar cheese. Peaks: a) 1: tyramine (154.1 mg/kg), 3: histamine (12.5 mg/kg); b) 1: tyramine (653.2 mg/kg), 2: putrescine (55.2 mg/kg), 3) histamine (15.2 mg/kg).

Experimental

A Dionex ICS-3000 Reagent-Free™ ion chromatography (RFIC™) system consisting of a DP dual gradient pump, EG eluent generator with an EGC II MSA cartridge, and a DC detector compartment with dual temperature zones and an electrochemical cell installed in the upper compartment. The lower DC column compartment was set to 40 °C and equipped with an IonPac® CG18 (2 × 50 mm) and a CS18 (2 × 250 mm). The first pump of the DP was set at 0.30 mL/min for the columns and the second pump was used to provide a postcolumn addition of 0.1 M NaOH at 0.24 mL/min to a mixing tee. The electrochemical cell was outfitted with a Au working electrode and a pH-Ag/AgCl reference electrode set in the pH mode. The electrochemical waveform was +0.13 V from 0.000 to 0.040 s, +0.33 V from 0.500 to 0.210 s, +0.55 V from 0.220 to 0.460 s, +0.33 V from 0.470 to 0.536 s, −1.67 V from 0.546 to 0.576 s, +0.93 V from 0.586 to 0.626 s, and +0.13 V at 0.636 s. Cheddar cheese samples were prepared by a procedure similar to that described previously (4). A portion of the ground cheddar cheese was allowed to spoil by storing at ambient temperature for one week.

Results and Discussion

An IC method with IPAD was developed for the determination of tyramine, putrescine, cadaverine, histamine, spermidine, and spermine in cheese. During the preparation of fermented foods, such as cheese, the presence of some microorganisms that are capable of producing biogenic amines is expected. Figure 1, chromatogram A shows the separation of amines in fresh cheddar cheese stored at 4 °C prior to analysis. As shown, a relatively high concentration of tyramine was detected in the sample. Upon spoilage, tyramine increased more than four times its original concentration while histamine only increased slightly (Figure 1 chromatogram B). Tyrosine decarboxylase activities have been detected in *Escherichia coli* and *Enterococcus faecalis* has been associated with tyramine in Cheddar cheese (1). The presence of high levels of microorganisms capable of producing tyramine may explain the significant concentration increase in the spoiled cheese. The use of IC with amperometric detection provided the sensitivity required to detect low concentrations of biogenic amines in cheese.

References

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