[S7-5]

Application of Electronic Nose for Food Materials

Bong-Soo Noh*, Chae-Ran Lim, and Jin-Young Choi[1]

Dept. of Food and Microbial Technology, Seoul Women's University
[1]Dept. of Food and Nutritional Sciences, Hanbuk University

Introduction

Food materials can be deteriorated due to chemical reaction or contamination of microorganism during distribution process and storage. Chemical analysis is a fast method while counting of microorganism is a slow analyzing method that needs several hours or days. Classical microbial evaluation of perishable foods is of limited value for predictive prognoses since these foods are sold or eaten before the microbiological results become available. As a result of these problems, many workers in recent years investigate the techniques measuring chemical changes produced by bacteria rather than measuring the total numbers of bacteria [1].

Volatile component of the fresh material is totally different from that of the deteriorated materials. Even if product was not deteriorated, quality of product could be changed after manufacturing. So quality of food materials can be controlled by monitoring changes of flavor components. Headspace analysis by GC or GC/MS can identify and quantify the composition of volatile compounds. That is precise and objective, but functions only on specific parts of smell and taste, though not always on parts considered most significant by the human senses. Moreover, skilled people are necessary for the interpretation of the data along with sample extraction and pretreatment time for GC analysis. Besides, excessive external reagents, complicated sample preparation methods and time-consuming procedures are required. It's not easy to detect the specific compounds and control quality of food materials. The electronic nose was an instrument, which comprised of an array of electronic chemical sensors. E-nose measures the changes in resistance of a patterned sensor surface upon interaction with volatile compounds/microbes that can be amplified and analyzed through a database capture software system [2]. E-nose system showed only differentiation between control and other sample or discrimination of original product for authentification of product using an appropriate pattern-recognition system, capable of recognizing simple or complex odors [3].Principal component analysis (PCA) or artificial neural network system could be used for

discrimination of different samples. Most works carried out with electronic noses successfully solve different classification problems. To date, there have been few contributions aimed at quantitative analyses, but the results obtained in this field show the potential of instruments in quantification tasks.

Application of E-nose

Prediction of shelf-life for milk : Milk was stored at 4, 15, and 30^{o}C for 14 days. The ratio of the measured resistance of volatile compounds to that of fresh air by electronic nose was expressed as sensitivity. The first principal component score was reduced from positive score to negative score as the storage time increased. It was possible to predict freshness of milk by the portable electronic nose [4].

Prediction of shelf-life for soybean curd : The neural network analysis program to predict the shelf life of soybean curd by using the electronic nose was developed. The known data of soybean curd were used as the database to learn the neural network system. The input patterns and target patterns were programmed for back propagation of learning algorithm. The input database was constructed from determination of volatile compounds in soybean curd by using the electronic nose at different temperature. After learning the input database by neural network system, the measured data of the unknown samples by the electronic nose were analyzed by the learned neural network analysis program for prediction of shelf life of soybean curd. The shelf life of the unknown soybean curd samples were predicted [5, 6].

Discrimination of the habitat for agricultural product : The habitats of agricultural product were investigated by the using electronic nose without any pretreatment. The difference of Canonical discriminant score in case of using both sensors rather than one was distinctly shown. Chinese product and domestic one could be distinctly discriminated from each other using composite sensing systems of the electronic nose [7].

Pathogen contamination of beef : The ability of an electronic nose, comprising a surface acoustic wave (SAW) resonator detector, to measure off-odors caused by spoilage or pathogen contamination of beef was examined. For assessment of the spoilage, aroma was measured with the passage of time. For rapid detection of food borne pathogens, odors from growth media and beef contaminated with pathogenic bacteria were also analyzed. Classifying beefs according to their storage days was possible using PCA. PCA analysis performed to classify odors of pathogens showed that the odors for uncontaminated growth medium were differently grouped from the odors of contaminated one. The electronic nose system could detect odors of *Salmonella typhimurium*, *Salmonella enteritidis*, and *Escherichia coli* [8, 9].

Discrimination of different pathogenic bacteria : Each microorganism produces different types of metabolic product. Electronic nose based on GC with SAW sensor system (Z-NOSE) can show different pattern of volatile component from different bacteria. Different species could be easily discriminated using Vapor Print system. Application of electronic nose is suited for quality control and process monitoring in field of fermentation [10].

In future the electronic nose would be also useful for a wide variety of biotechnology when correlating analytical instrumental data with the obtained data from electronic nose.

References

1. TK Singh, and KR Cadwallader The shelf life of foods. ACS Sym. Series 836, pp. 2-21 Am. Chem. Soc., Washington, D.C., USA (2002)
2. S Magan *Sens. Actuators* **B 72,** 28 (2001)
3. BS Noh *Korean J. Food Sci. Technol*. **37,** 1048 (2005)
4. SH Ko, EY Park, KY Han, BS Noh, and SS Kim *Food Eng. Progress* **4,** 193 (2000)
5. EY Park, JH Kim, BS Noh *Food Sci. Biotechnol*. **11(3),** 320 (2002)
6. AR Youn, BS Noh *Food Sci. Biotechnol*. **14**, 437 (2005)
7. BS Noh, JW Ko, SY Kim, and SJ Kim *Korean J. Food Sci. Technol*. **30,** 1051 (1998)
8. G Kim, MW Lee, KJ Lee, CH Choi, KM Noh, S Kang, and YC Chang *J. Biosystems Eng.* **30(2)**, 121 (2005)
9. SM Younts, EC Alocilja, WN Osburn, S Marquie, DL Groom *Trans. ASAE* **44**, 1681 (2002)
10. C Pinheiro, CM Rodrigues, T Schäfer, JG Crespo *Biotechnol. Bioeng*. **77(6),** 632 (2002)
11. T Bachinger, P Martensson, C-F Mandenius *J. Biotechnol*. **60**, 55 (1998)