

Discrimination of black onion flavor using the electronic nose

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Abstract: The flavor of onions at different processing times (0, 6, 14, 20 days) were monitored by electronic nose. Different sensors were sensitive to different compounds. The results showed that the sulfur compounds were the major components in the onions, which decreased significantly with the increasing of the processing time. What is more, the flavor of the onions could be differentiated clearly by electronic nose. The linear discriminant analysis (LDA) model could be applied to distinguish the samples efficiently.

Introduction

Onion is one of the most important spices in China and other countries, such as India and America. It is famous for its unique flavor and functional properties. There have been many researchers reported that onion was a major source of antioxidants. *Bora Lee* had reported that onion could enhance the activity of plasma SOD and GPx and inhibit the liver lipid peroxidation [1]. Besides, because of the higher content of organosulfur compounds [2], it had widely used as feed additives [3], food ingredients [4] and anti-inflammatory [5]. Today, onion was consumed as fresh, as oil, and in paste in the market currently. In order to change the eating quality, fermentation was used to process the product. Black onion was a rising functional food that made from raw onion in hot and humid environment for nearly one month.

Electric nose is an intelligent technique that simulated the biological sense of smell. It had been used to investigate and control quality of food and vegetables [6], monitor the shelf life of the product [7], and distinguish the flavor characteristics [8].

The aim of this study was to monitor the change in flavor of the black onion during the processing using PEN 2 E-nose by PCA.

Materials and methods

Materials

Purple onion was obtained from a local market in Beijing.

Experimental setup

The whole purple onion was placed in a humidity Chamber (GDS-225, Yashilin, Beijing), which procedure set at 70 °C under 90% relative humidity (RH) for 20 days. The onion was removed out under different times (0, 6, 14, 20 days). All the samples were maintained at -80 °C until analysis.

Electric nose measurement

All the experiments were performed using an AIRSENSE PEN3 electronic nose, which consist of 10 different metal oxide sensors. The different sensors were sensitive to different areas [9]. The instruments should be pre-warmed for 30 min prior the measurement. 2 g onion paste was weighted and placed in a sealed vial with volume of 20 mL. Before analysis, the system should be purged with the ambient air under 180s for 2 times. Then, the samples were conducted for 60s for analyzing. It should be noted that the system must be cleaned for 180s again before the next sample was inlet.

Data collection and statistical analyses

The data between 48s-52s were utilized. Principal component analysis (PCA) and linear discriminant analysis (LDA) were performed by WinMuster software to discriminate between the different classes of samples. All samples were repeated in three times.

Results and Discussion

The sensor of onion aroma

Fig. 1 shows a typical signal of 10 sensors for onion which at different times. Each curve represents one sensor response value. The G/G_0 (G_0/G) values response to volatiles were varied with different samples. As for onion, it can be seen that sensor 2, 7 and 9 were increased remarkable. The rest sensors almost had not change. Sensor 2, 7 and 9 were sensitive to nitrogen oxides, sulfur compounds and aromatics compounds, sulfur organic compounds, respectively. As is known that, onion is rich in sulfur compounds, which illustrated that the electronic nose could explain the flavor of the onion. Fig. 2 displays the response values of electronic nose sensors for onion at 0, 6, 14, 20 days. As shown in the figure, the values of the three important sensors decreased significantly with the increasing of the time. It is consistent with the human sensory, which found that the pungent flavor of onion at 20th days decreased significantly. The taste of the onion became more easily acceptable by people.

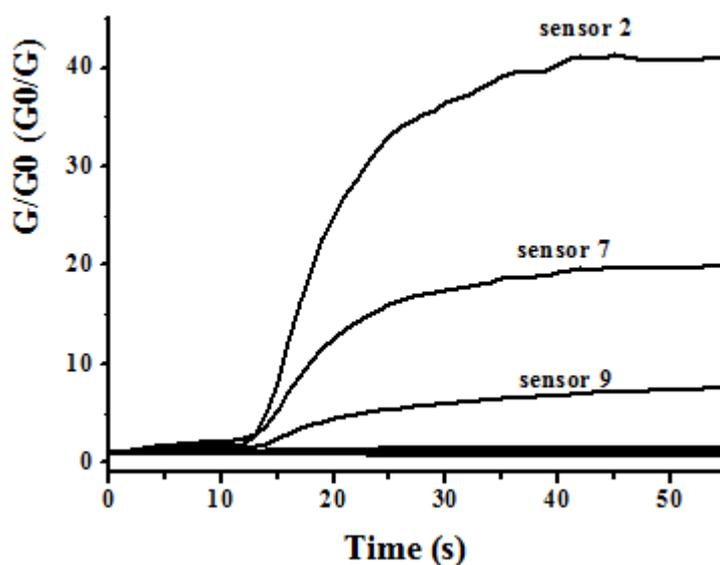


Fig. 1 The graph for response of sensors to onion aroma

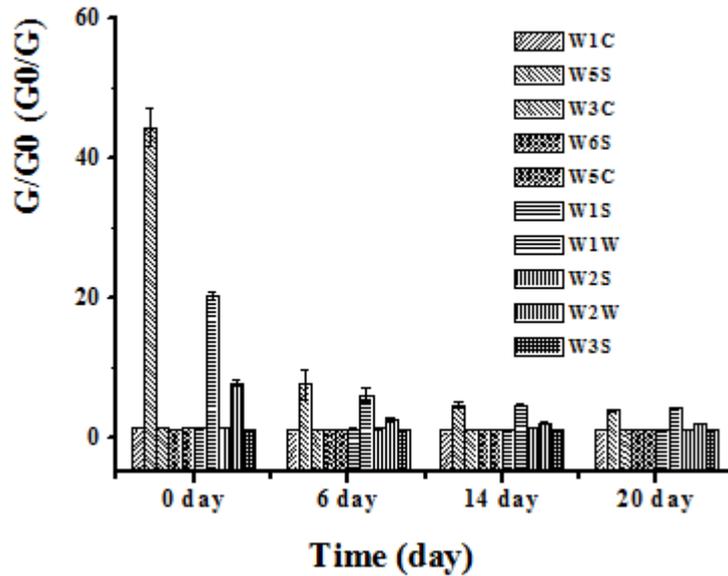


Fig. 2 Response values of electronic nose sensors for different onions

Principal component analysis (PCA) and linear discriminant analysis (LDA)

The PCA result was shown in Fig. 3. The PCA shows the differentiation of the four kinds of onions. According to the PCA analysis, two main principal components were obtained for the onions, which PC1 explained 99.97% of the total data variance, PC2 explained 0.03%. The onion at 0 day could be distinguished clearly from others, whereas the differentiation between the onions at 6, 14, 20 days were not so clear. Linear discriminant analysis (LDA) was a useful method to maximize the differentiation between the samples. As shown in LDA plot, two liner discriminants explained 95.99% of the total variance (LD1 for 81.51% and LD2 for 14.48%). From the plot, it can be seen that he electronic nose was able to differentiate clearly the onions at different periods (0, 6, 14, 20 days).

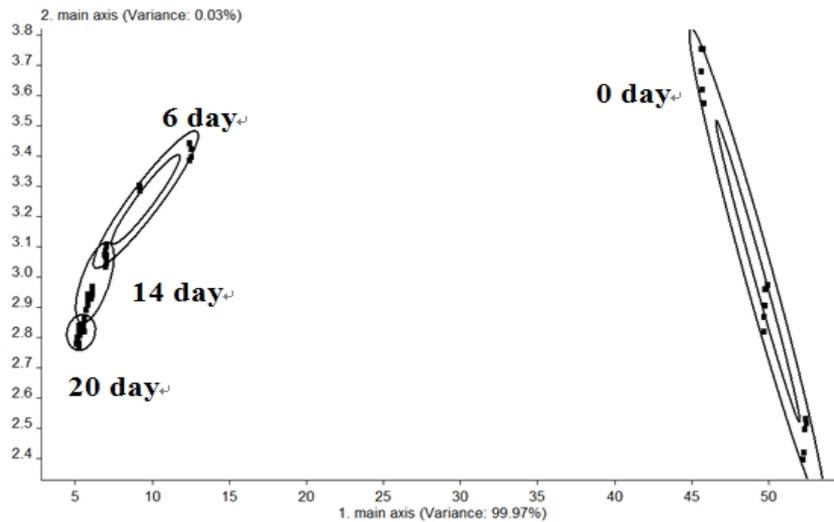


Fig. 3 PCA analysis for the onion processed for different times

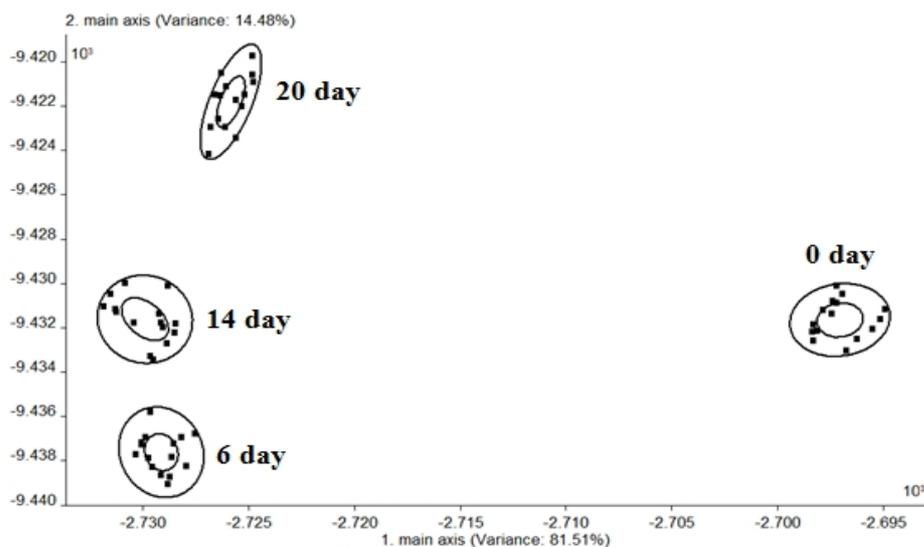


Fig. 4 LDA analysis for the onion processed for different times

Conclusions

The results of this study explained that electronic nose could be applied to distinguish the odor of onions at different times efficiently. What is more, LDA model could differentiate the samples more clearly comparing to the PCA model.

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References

- [1] Lee, B., Jung, J.H., Kim, H.S., 2012. Assessment of red onion on antioxidant activity in rat. *Food and Chemical Toxicology* 50, 3912–3919.
- [2] Lanzotti, V., 2006. The analysis of onion and garlic. *Journal of Chromatography A* 1112, 3–22.
- [3] Goodarzi, M., Nanekarani, G., 2014. Effect of onion extract in drink water on performance and carcass traits in broiler chickens. *IERI Procedia* 8, 107 – 112.
- [4] Eduvigis Roldán, Concepción Sánchez-Moreno, et al, 2008. Characterisation of onion (*Allium cepa L.*) by-products as food ingredients with antioxidant and antibrowning properties. *Food Chemistry* 108, 907–916.
- [5] Natasa, S., Dejan, O., Dragana, C.S., et al, 2013. Phenolic profile, antioxidant, anti-inflammatory and cytotoxic activities of small yellow onion (*Allium flavum L. subsp. flavum*, Alliaceae). *LWT - Food Science and Technology* 54, 139–146.
- [6] Abbott, J.A., 1999. Quality measurement of fruits and vegetables. *Postharvest Biology and Technology* 15, 207–225.
- [7] Antihus Hernández Gómez, Wang, J., et al, 2008. Monitoring storage shelf life of tomato using electronic nose technique. *Journal of Food Engineering* 85, 625–631.
- [8] Grigioni, G., Carduza, F., et al, 2004. Flavour characteristics of *Ilex paraguariensis* infusion, a typical Argentine product, assessed by sensory evaluation and electronic nose. *J Sci Food Agric* 84, 427–432.
- [9] Liu, P., Tu, K., 2012. Prediction of TVB-N content in eggs based on electronic nose. *Food Control* 23, 177e183.