4C4) Variation of Volatile Organic Compounds Released during Food Decaying Processes

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1. Introduction

Food decaying processes are considered one of the major contributors to malodor problem. Among various odorants, VOCs gained a great deal of attention because of their harmfulness to human and animal. Nowadays, policies for food waste management are generally implemented by many countries to encourage composting for resource recovery, as quality compost is valuable in agricultural applications (Mao et al., 2006). However, odorants released during such processes can deteriorate environmental health and quality of life. In addition, composting municipal biodegradable solid wastes contributes considerably to VOC emissions in the atmosphere. Komilis et al. (2004) found that the net mass production of 13 VOCs released from food wastes was 2.504mg per dry kg of food wastes during the composting of municipal solid wastes. Moreover, VOC species released from biodegradable wastes are abundant to cover up to ninety species (Wilkins, 1994). Quantitative analysis of VOCs released from foods or their wastes has also advanced to help control food and environmental protection. Mayr et al. (2003) investigated the spoiling of meat by measuring VOCs using PTR-MS. Kim and Park (2008) studied the relationship between direct (olfactometry) and indirect (instrumental) methods for detecting odors including VOCs generated from food and beverage production, waste treatment, and some miscellaneous industrial facilities. Because food decaying processes produce and release various types of VOCs, it is important to describe relationships between food types and VOCs during their decay. In this study, we determined the emission concentrations of VOCs during food decaying processes. Variations of their concentration levels due to food decaying processes were measured as a function of time.

2. Materials and methods

A total of 7 VOCs were selected and investigated which include acetone (AC), methyl ethyl ketone (MEK), toluene (T), ethylbenzene (EB), m,p-xylene (MPX), styrene (ST), and o-xylene (OX). The concentrations of each individual analyte were quantified from all three types of food samples consisting of Kimchi (KC), fresh fish (FF), and salted fish (SF). For each food type, the fresh samples were used to initiate the experiments. Five grams of each food were placed inside a 100mL (needless throwaway) syringe. Each syringe was then filled with air to make the total volume at 60 mL (without restricting the exchange of air). For each food type, a total of 5 samples were prepared to measure the concentration of VOCs at varying intervals up to 14 days. The samples were stored at room temperature and retrieved at each measurement interval. The collection and treatment of VOC samples were made by routine sampling procedures. 25mL of gases accumulated within a throwaway syringe was used for analysing VOCs. The analysis of VOCs was done with a major emphasis on AC, MEK, and 5 aromatic compounds (T, EB, MPX, ST, and OX). The GC system (Agilent 6890N model, Agilent Technologies, US) equipped with the Agilient 5973 inert Mass Selective Detector (MS) was used for the analysis of these compounds.

3. Results and discussion

Comparison of TVOCs indicates that the values derived from two types of fish samples were similar with the mean of 280±579 (FF) and 504±1,089ppmC (SF). However, that for KC was noticeably lower with 16.4±7.6ppmC. According to our analysis, ST recorded the highest mean value followed by T, EB, and MPX (Figure 1). Variations in odor components of KC sample were weaker than that of SF and FF. If the variability of concentration is expressed in terms of coefficient of variation (CV) for a given compound, ST showed the largest variation among odors with the CV of 89, 222, and 223 from KC, FF and SF samples, respectively. The lowest CV of odors was found at 46 for MPX (KC), whereas MEK showed 59 and 89 for the FF and SF samples, respectively.

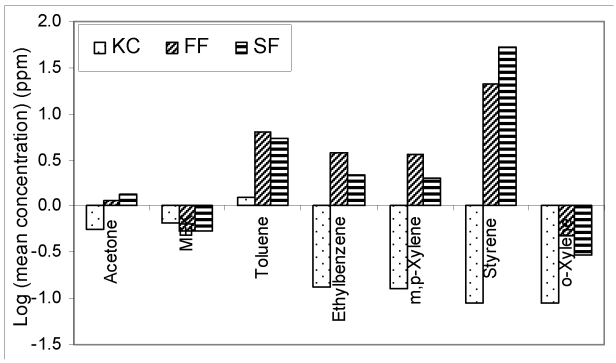
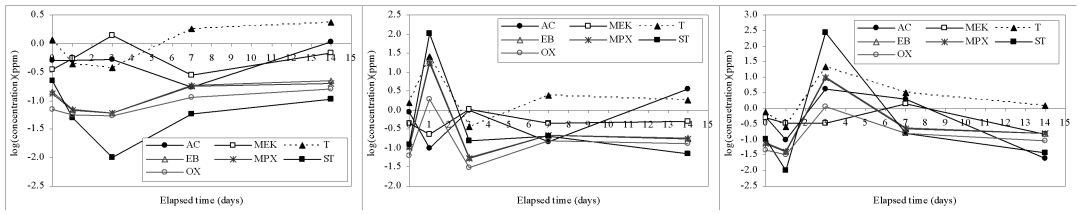


Fig. 1. Comparison of the mean concentrations of VOCs released during food decay in this study.

Figure 2 shows that the temporal variation of VOC species during decay is similar between the two fish types (FF and SF), while they are significantly different from KC. Differences in the substrate type can be another factor to consider for the control of VOC emissions during the decaying process. If the daily concentration range of TVOC are compared between food types, those of KC (1.73 to 4.85 ppm) are significantly smaller than two fish foods of FF and SF (0.82 to 312ppm). The results of our study confirm that each odorant tends to maintain a similar pattern of odor production in relative terms for a given food type. However, the emission magnitude of each odorant can be discriminated among different food types.



[KC] [FF] [SF]

Fig. 2. Temporal variation of VOC in log (concentration) (ppm) during the food decay experiments. The statistical analysis of our emission concentration data showed that there are high variations in concentration levels of different odorant species. The temporal variation of odorants, examined in this study, showed that the patterns for each odorant exhibit fairly diverse trends. Similarly, the gas analysis during the aerobic composting process of biowaste revealed a strong difference in emission profile as a function of time between different groups of volatiles (Smet et al., 1999).

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