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Study of white truffle aging with SPME-GC-MS and the Pico2-electronic nose

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Abstract

We observe the change of aromatic compounds in the headspace of white truffles (Alba's Truffle) after storage at +4 °C over a period of a few days. Measurements have been performed using SPME-GC-MS technique and the Pico2-electronic nose (EN) developed at Sensor Lab. in Brescia. The EN shows a very high sensitivity towards the truffle's relevant molecules such as 2,4-dithiapentane and is able to detect gasses from truffle samples up to a mass of the order of 10 mg. As for truffle aging, results obtained with both techniques are strongly correlated and confirm that there is a variation of the truffle's headspace after circa 5 days.

Keywords: White truffle; Shelf-life; Electronic nose; Metal oxide sensors; Headspace analysis; SPME-GC-MS

1. Introduction

Electronic nose (EN) technology has been widely employed in the past in various fields: automotive, environmental monitoring, medical diagnostic, quality control of food and beverages. At present, it seems very difficult to create an all purpose instrument, so the trend is to develop systems for specific applications. Food quality assessment is one of the most promising applications, as demonstrated by the large amount of publications on this topic, see e.g. [1,2] for an overview.

From the methodological point of view, food analysis applications can be divided in two main groups: *static* classifications, e.g. different sample recognition, and *dynamic* classifications, e.g. monitoring the time evolution of a certain product throughout its lifetime [3]. In dynamic classification, usually the final task consists of distinguishing between fresh food (on shelf) and aged food (off shelf). EN has been applied to solve problems such as fruit and vegetables ripening control [4], fish and meat freshness monitoring [5], shelf-life evaluation of different preserved foods [6]. All these works report preliminary results which make the EN technology very interesting for a quick and objective evaluation of food aging.

In this work, we study the relative change of the white truffle's aroma (*Tuber magnatum* Pico) in the days following the harvesting, in order to determine the maximum preservation time for the white truffles (Alba's truffle). The flavour of the white truffle is mainly characterized by four parameters: the type, the origin, the ripening and the freshness (aging). The truffle freshness is extremely important for both consumer's safety and commercial points of view, i.e. determining the quality and price of the product. It would be therefore interesting to have a reliable system for truffle freshness evaluation.

It is well known that the truffle's aging implies several biochemical reactions, which cause the changing of flavour with time. Investigations about the time variation of truffle headspace composition have been performed on *Tuber aestivum* [7], *Tuber melanosporum* [8] and *Tuber borchii* [9]. Different storage conditions have also been explored. In all the cases, a strong flavour variation has been observed during a few days. Usually, in the fresh sample aroma, there are few molecules or even a single relevant molecule that play an important role. For *Tuber melanosporum*, two aldehydes (2- and 3-methylbutanal) and two alcohols (2- and 3-methylbutanol) are the relevant compounds, while 1-octen-3-ol is the main molecule in the headspace of fresh *Tuber borchii*. With time, an increase of alcohols and sulphur compounds have been observed and attributed to the fermentation process.

Tuber magnatum Pico is the most esteemed truffle type. DNA analysis is the main technique employed to investigate this white truffle [10]. Currently, few publications concerning headspace composition exist [11], while no work about

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headspace time variation of *Tuber magnatum* has been performed.

Here, two different techniques have been applied for the headspace analysis. The first one, SPME-GC-MS, allows us to obtain quantitative information about the compounds of the truffle headspace but is a complex and time consuming method. The second one, EN, is a promising technique to objectively investigate the aroma fingerprint of black and white truffles. The portable nose PEN-2 (Airsense, Germany) has been employed to certify the quality of *Tuber melanosporum* black truffles [12], while an EN equipped with semiconducting metal oxide (SMO) and metal oxide semiconducting field effect transistor (MOSFET) sensors have already been used to evaluate the white truffle quality, training the system with the sensorial analysis results [13]. Concerning quality assessment, MOSFET sensors provided better results in

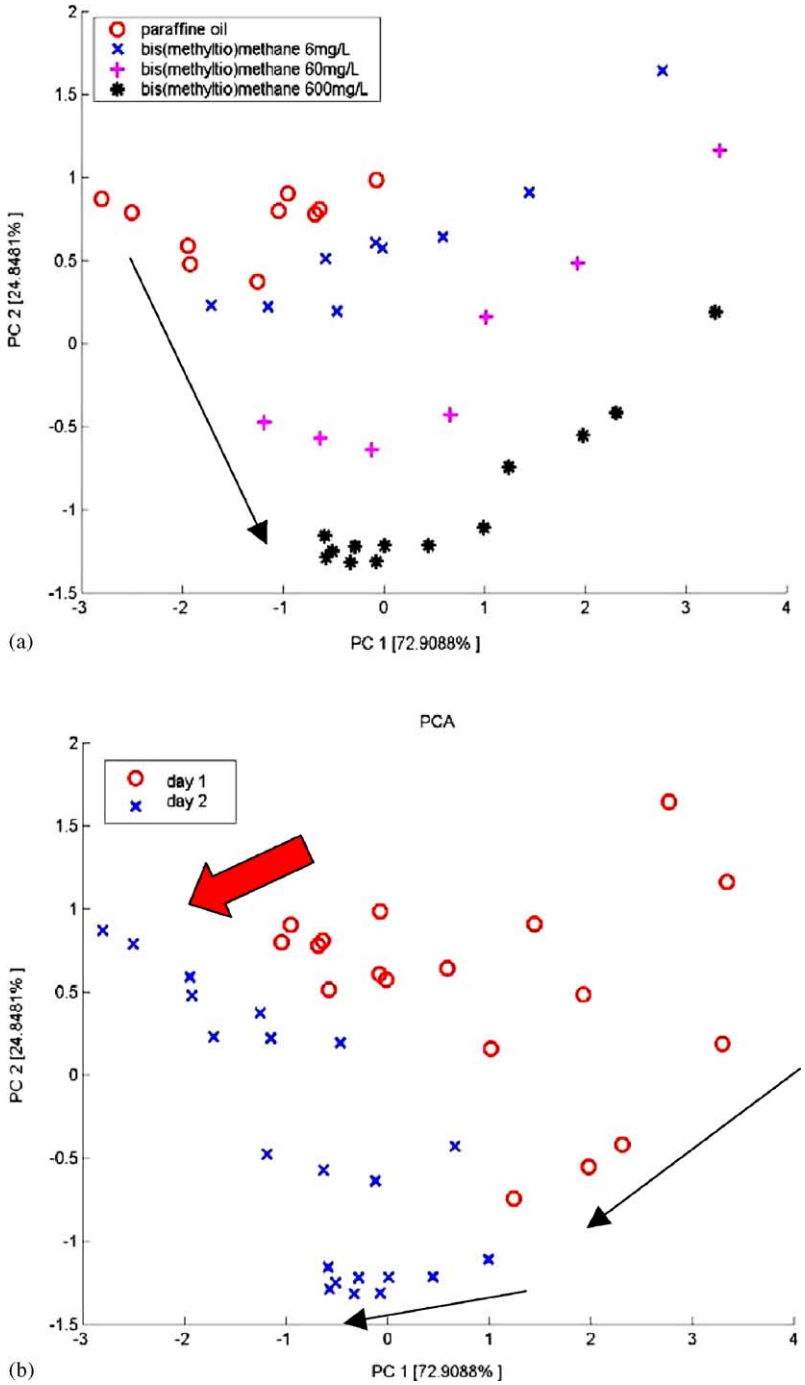

Fig. 1. (a) The PCA plot shows the response of Pico2-EN for increasing concentrations (as indicated by the black arrow) of bis(methylthio)methane diluted in paraffin oil. The response towards pure paraffin oil is also displayed. (b) The PCA displays the same data vs. the day of measurements. The thick arrow shows the variation due to measurements performed in different days, the two thin arrows indicate the order of subsequent extractions (from the first to the last) performed on the same vial.