Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 170 (2017) 357 – 362

Procedia Engineering

www.elsevier.com/locate/procedia

Engineering Physics International Conference, EPIC 2016

Optical characterization of major compounds in different types of commercial olive oil using photoluminescence method

Adhika Widya Sena[a]*, Isnaeni[b], Endang Juliastuti[a]

[a]*Laboratory of Optical Instrumentation and Imaging, Bandung Institute of Technology, 40132 Bandung, Indonesia*
[b]*Research Center for Physics, Indonesian Institute of Sciences, 15314 Banten, Indonesia*

Abstract

Olive oil is a vital component in Mediterranean diet which is highly recognized for its health benefits, including but not limited to improving cardiometabolic markers, reducing incidence of neurodegenerative diseases and boosting cognitive performance. Despite the fact that olive oil has been widely used across the globe, the existing research is still focused on extra virgin olive oil per se, ignoring the fact that other olive oil types (such as classic and extra light) are also commonly used in our society. Moreover, most research still used long-procedure chemical methods to examine olive oil, only very little research used an optical approach. In this study, we identified the major compounds in 3 types of commercial olive oil (classic, extra virgin and extra light) from different brands using photoluminescence method. A 355 nm Nd:YAG laser was used to trigger emissions from the olive oil sample which were then analyzed using a spectrophotometer. We managed to identify 4 oxidation products, 2 Vitamin E compounds and 2 chlorophyll compounds. The results from deconvolution using a Lorentzian profile showed that each olive oil type has a unique compounds proportion with chlorophyll as the most dominant substance. The composition consistency of each brand also varies, inferring different qualities between commercial olive oil products. Finally, we discussed the benefits of deconvolution and photoluminescence methods to characterize major compounds in different types of commercial olive oil. In conclusion, photoluminescence is a valid optical characterization method to characterize the compounds in different types of olive oil.

Peer-review under responsibility of the organizing committee of the Engineering Physics International Conference 2016

Keywords: Olive oil; photoluminescence; optical characterization; classic olive oil; extra virgin olive oil; extra light olive oil

1. Introduction

Olive oil is a widely used cooking and diet component in the world, mainly for Mediterranean dishes. Its health benefits are highly recognized, from improving cardiometabolic markers to boosting cognitive performance [1,2]. There is also numerous research that have been done to examine the chemical components of olive oil. However, the research is still focused on extra virgin olive oil per se, excluding other major olive oil types, such as classic and extra light. In fact, both products are also commonly used in our society and commercially distributed by international companies overseas. On top of that, most research still used long-procedure chemical methods to treat olive oil, break down its chemical components and analyze the merit of each component, only very few research used an optical approach. This phenomenon illustrates the impracticalities of mainstream olive oil research. The use of chemical treatments wears off the sample. It also requires a longer waiting time for the sample to be ready to be analyzed.

This research was aimed to provide more knowledge in regards to three major types of commercial olive oil sold in the market: classic, extra virgin and extra light, mainly about major chemical compounds contained within each product. A fast optical characterization method (using a photoluminescence spectroscopy) was applied as opposed to long chemical procedures to provide fast chemical reading of the olive oil samples and to distinguish one major chemical compound from the others, while also preserving the chemical state of the samples. The relative proportion of each chemical compound was also measured. An

* Corresponding author. Tel.: +62-856-720-9407
E-mail address: adhikawidyasena@gmail.com

Peer-review under responsibility of the organizing committee of the Engineering Physics International Conference 2016
doi:10.1016/j.proeng.2017.03.053

analysis of the relative proportions between different major chemical compounds can be used as an indicator that infers the quality of each product from different brands which also verifies the health benefits claims of different types of olive oil.

2. Methods

2.1. Olive oil sample preparation

There are a lot of olive oil brands in the market, dominated by international brands from companies based in Mediterranean countries, such as Spain, France and Italy. Each brand usually produces at least three different types of bottled olive oil: classic, extra virgin and extra light, while other more specific olive oil products are also produced. To ensure the homogeneity of the samples, in this experiment, we used 9 samples consisted of 3 different types of bottled olive oil: classic (will later be inferred as 1), extra virgin (2) and extra light (3) from 2 different Italian brands (will later be inferred as A and B) and 1 Spanish brand (C). So a classic olive oil product from the Spanish brand will be inferred as C1. These products were bought on local supermarkets and protected from light exposition. Fluorescence spectra were recorded without pretreatment nor dilution of the samples. The samples were also protected from excessive exposure of lights.

2.2. Experiment

Each sample was put in a quartz cuvette and excited by a Nd:YAG laser emitting pulses at a wavelength of 355 nm through a free space. A Nd:YAG laser with a wavelength of 355 nm was chosen because the excitation wavelength range is between 300 nm to 390 nm [3]. A convergent lens was placed between the laser and the quartz cuvette. A collimator and another convergent lens were put at an angle from the quartz cuvette to harvest the fluorescence and focusing it to a spectrometer (OceanOptics USB HR2000) coupled to Sony ILX511 linear silicon CCD array. This spectrometer can detect signal between 314.54 nm 762.25 nm with a 0.45 nm resolution.

To ensure the repeatability of the data gathered, each spectrum represents the average of 3 data captures. Each spectrum was then fitted into a wavelength-photoluminescence (PL) intensity graph before deconvoluted using a Lorentzian profile. Lorentzian profiles can be used to identify a single peak of a graph or several peaks that build the whole graph [4,5]. The deconvolution is applied to identify the peak of each component with fluorescence emission in every sample, so the overall compounds can further be analyzed.

3. Results and Discussion

The spectra of all three types of olive oil are gathered in **Fig. 1**.