Rapid Detection of Methanol in Artisanal Alcoholic Beverages

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ABSTRACT

In the industry of artisanal beverages, uncontrolled production processes may result in contaminated products with methanol, leading to risks for consumers. Owing to the similar odor of methanol and ethanol, as well as their common transparency, the distinction between them is a difficult task. Contamination may also occur deliberately due to the lower price of methanol when compared to ethanol. This paper describes a spectroscopic method for methanol detection in beverages based on Raman scattering and Principal Component Analysis. Associated with a refractometric assessment of the alcohol content, the method may be applied in field for a rapid detection of methanol presence.

Keywords: Raman Spectroscopy, Beverages Contamination, Pattern Recognition

1. INTRODUCTION

In the past years, the market for artisanal beverages as well as the number of reported cases of intoxication by contaminated products have experienced a worldwide expansion. Concerned with the statistics of injuries caused by methanol ingestion, governments have issued warnings about the dangers of drinking home-distilled spirits. In commercially made spirits manufacturers use technologies to separate the methanol from the blend, which makes safe hey consumption. However, the uncontrolled manufacturing technologies employed in the production of home-distillated spirits may result in high levels of methanol content in the beverage. In other cases, unscrupulous enterprises deliberately add methanol to alcoholic beverages. Due to its lower price when compared to ethanol, methanol employment to tamper with beverage has been pointed out as a current risk for consumers[1]. Methanol ingestion may lead to metabolic acidosis, vomit, nausea, blindness and even death, depending on the consumption. Lethal dose ranges from 0.3 to 1 g per kilogram of body mass. By considering a 200 ml volume ingested by a 70 kg-weight individual, this upper limit relates to 70 g of methanol. However, even for amounts far bellow this high level of consumption, there is a risk of intoxication by considering a long-term use[2].

A number of methods for alcohol analysis involving density of color with auxiliary chemicals, as well as demanding techniques employing gas chromatography, rely on complex and/or time-consuming sample handling processes. For a faster assessment, the measurement of the sample refractive index with a handheld refractometer to determine the ethanol content in beverages is widespread in the field artisanal beverages. A drawback of such method comes from the proximity between the water and methanol refractive indexes, which may mask the presence of this alcohol in the blend. Similarly, determining the ethanol concentration in beverages via density measurements is also misleading, as ethanol and methanol present close density values. Association of Official Agricultural Chemists standardizes such methods, and a comprehensive list can be found in the literature[3,4]. Taking into account that an unambiguous characterization requires specialized laboratories and skilled manpower, not always readily available at the production or consume sites, a simple and reliable method to analyze the toxicity of beverage regarding the presence of methanol is very important for the sector.

This work presents preliminary results obtained with an alternative technique proposed to verify the nominal alcohol content in beverages. The method indicates if methanol is present in the blend in contents above a pre-set threshold. An optical fiber Raman spectrometer, complimentary to the refractometric and/or density measurements, establishes a possible contamination in a fast procedure. Instead of determining with high accuracy and low uncertainty the methanol concentration, as described in the Raman-based method reported by Boyaci *et al*[5] that depends on the addition of an standard, we focus on the PCA (Principal Component Analysis) tool for a preliminary toxicity determination without sample pre-processing.

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