Carbonyl value in monitoring of the quality of used frying oils

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Abstract

In this study, a set of frying oil samples of different compositional properties but passed qualitative and quantitative standards, which were of various vegetable oil sources (individually or as blends), were obtained from seven of big oil factories in Iran. Before starting the frying process, all the frying oils had carbonyl values (CV) higher than 2 μmol g⁻¹. The CV of most frying oils linearly increased until the end of the frying process, whereas for some of them, the CV increased and reached a maximum and then decreased to some extent. However, in a set of frying oil samples on average, the CV linearly increased as the frying time increased. There was a linear relationship between the CV and total polar compounds (TPC) throughout the frying process with a high determination coefficient ($R^2 = 0.9747$). The values found for carbonyl compounds of the frying oils during frying process ranged from 7.76 ± 0.00 to 123.45 ± 3.70 μmol g⁻¹. Assuming that the limit of acceptance for TPC is 24%, this was roughly corresponded to 43.50 μmol g⁻¹ for CV.

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1. Introduction

Frying of foods is a very popular way of cooking at home and in fast-food restaurants [1]. It is a fast, convenient and energy-efficient cooking method that increases palatability due to fat absorption, crust formation, and pleasant flavors and odors [2]. However, it is well known that frying oils used continuously at high temperatures in the presence of oxygen and water from the food being fried, are subject to thermal oxidation, polymerization, and hydrolysis, and the resultant decomposition products adversely affect flavor and color [3–5]. In addition, undesirable constituents produced from degraded frying oils may even be harmful to health [6].

Peroxide value (PV) is one of the most frequently determined quality parameters during oil production, storage, and marketing. The PV shows the degree of oxidation in the substance and measures the amount of total peroxides as a primary product of oil oxidation [7]. Che Man et al. [8] reported a decrease in the PV of oil samples after an initial increase. A significant decrease of the PVs after reaching maximum values confirms that peroxides, which are formed during the early stages of oxidation, are unstable and highly susceptible to further changes that results in the formation of secondary oxidation products [9]. Therefore, Fritsch [10] has stated that the determination of PV is not suitable for the assessment of used frying oils. In contrast to the PV, carbonyl value (CV) does not measure primary products of oxidation, but secondary decomposition products such as aldehydes and ketones [11]. According to Woyewoda et al. [12], peroxides are transformed into secondary products that contain carbonyl groups. These compounds are more stable than peroxides and the CV seems to be a good index of oxidative changes in lipids. The determination of carbonyl compounds in frying oils is very important for evaluating the quality of frying fats and oils because these compounds often contribute to rancid and unpleasant flavors, and reduce the nutritional value of fried foods [13]. Endo et al.