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Application of the bespoke solid-phase extraction protocol for extraction of physiologically-active compounds from vegetable oils

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ABSTRACT

A possibility of harvesting the physiologically-active compounds from the vegetable oils using bespoke resin and optimised solid-phase extraction (SPE) purification method is demonstrated. The paper describes the application of SPE protocol, which was originally developed, using sunflower oil as model biomass, for extraction of the valuable compounds from sesame, wheat germ, palm, olive and soybean oils. As a result, the extraction of three free fatty acids (palmitic, oleic and linoleic), α-tocopherol and three phytosterols (campesterol, stigmasterol and β-sitosterol) from six vegetable oils have been demonstrated. The comparison between the published data on the amount of the analysed compounds in the corresponding vegetable oils and presented here extraction results confirm that the developed method allowed not only quantitatively extract the physiologically-active components from various vegetable oils without any pre-treatment but also was reproducible, cost-effective and ecologically-conscious as consumed smaller volumes of organic solvents than commonly used protocols.

Keywords: Solid-phase extraction (SPE); Vegetable oil; Free fatty acids; Tocopherol; Phytosterols

1. Introduction

The vegetable oils, such as rapeseed, canola, soybean, sunflower and palm oils, are commonly used biomasses for production of biodiesel. Considering that biofuel is a renewable and ecologically-friendly source of energy, extra efforts should be made to lower the cost of biodiesel, which could be done "by increasing feedstock yields, developing novel technologies, and increasing economic return"[1]. It is known that vegetable oils consist of 95 to 98% of triacylglycerol and 2 to 5% of different groups of minor components such as hydrocarbons, tocopherols, phytosterols and their esters [2–4]. Triglycerides are the main components of vegetable oils which are used for the production of biodiesel through their transesterification reaction with methanol or ethanol in the presence of the alkali catalyst [5-7]. Unfortunately, all these minor components of the vegetable oils, which are typically valuable physiologically active compounds, are completely lost during the biofuel production process. It is possible to envisage that recovering the 'bioactives' before the biofuel production could have added value to the biofuel production and make the cost of biofuel lower or at least comparable with traditional fossil fuels.

Apart of added value through the recovery of valuable ingredients of the vegetable oils, removal of some of them, particularly, free fatty acids, could make the biodiesel production more effective by preventing their reaction with the alkali catalyst during transesterification reaction, which usually requires a great amount of alcohol to maintain the equilibrium of the reaction and produce more methyl esters [5,6]. It was observed that the presence of free fatty acids negatively affects the production of biodiesel from the vegetable oils resulting in the production of the soap and water, thus inhibiting the separation and purification processes of the biodiesel production [6, 7].