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Editorial

Special Issue on "Applications of Chromatographic Separation Techniques in Food and Chemistry"

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Chromatographic techniques and methods are experiencing significant growth in various industries. Nowadays, chromatographic equipment is used for analytical purposes in every laboratory, research facility, and production plant that operates in the fields of organic, inorganic, physicochemical, biochemical, pharmaceutical, and cosmetic products; polymers; engineering; environmental protection; food technology; biotechnology; and many others. Chromatographic techniques are also increasingly used for preparative or process purposes. Chromatography is an extremely versatile technique. Gas chromatography allows for the rapid separation of gases and volatile substances. Non-volatile chemicals and materials with an extremely high molecular weight are most often analyzed by liquid chromatography and, if necessary, by the very inexpensive thin-layer chromatography coupled with densitometry. For this reason, chromatographic analyses are widely used research methods. Chromatographic analyses are used in virtually all industries, including the pharmaceutical industry, food processing industry, and chemical synthesis industry. They allow for the detection of even trace amounts of substances in the finished product, which, in turn, enables accurate quality control of food and pharmaceutical products. These techniques also allow for the monitoring of the purity of pharmaceutical products and newly synthesized bioactive molecules as potential new drug candidates, among other applications [1–10]. Pharmacopoeias also recommend chromatographic techniques for drug analysis [11,12].

In the first volume of this Special Issue on "Applications of Chromatographic Separation Techniques in Food and Chemistry" (https://www.mdpi.com/journal/processes/special_issues/Chromatographic_Separation_Techniques; accessed on 19 January 2024), 23 articles were published, including 2 reviews and 21 original articles. These publications were authored by 107 scientists from the following countries: Republic of Korea, Poland, Jordan, Iraq, Bulgaria, Saudi Arabia, Egypt, China, Italy, Canada, and the USA. Biologically active substances, including those tested in pharmaceutical preparations, herbs, and dietary supplements, were the subjects of most of these publications. In as many as eighteen publications, liquid chromatography, including high-performance liquid chromatography (HPLC) and thin-layer chromatography (TLC), was used to analyze biologically active substances. New thin-layer chromatography methods were developed for the simultaneous determination of vitamins B_1, B_2, B_5, B_6, and B_{12} in pharmaceutical products (determined in amounts below 1 µg/spot); vitamins K_1, K_2, MK-4, MK-7, MK-9, and D_3 in dietary supplements and pharmaceutical products (measured in amounts below 107 ng/band); and five coxibs, namely, celecoxib, etoricoxib, firecoxib, rofecoxib, and cimicoxib, in pharmaceutical preparations (measured at less than 300 ng/band). Of particular note is the development of green reversed-phase high-performance thin-layer chromatography (RP-HPTLC) combined with densitometry using a mobile phase composed of ethanol and water for the quantitative determination of diosmin in pharmaceutical products (diosmin determined in a range from 100 to 700 ng/band). Tests of sertraline and fluoxetine using the TLC-densitometric technique demonstrated that the appropriate selection of chromatographic conditions (the chromatographic medium and composition

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of the mobile phase) allowed for low limit of detection (LOD) and limit of quantification (LOQ) values to be obtained for the determined drugs. The next publication compared the possibilities of using TLC and reversed-phase–ultra-high-performance liquid chromatography (RP-UHPLC) for the simultaneous determination of fluomethasone pivalate and clioquinol in eye drops and the simultaneous determination of fluomethasone pivalate and clioquinol in the presence of a phenoxyethanol preservative in cream. Both methods were effective for the determination of fluomethasone pivalate and clioquinol. The next publication used liquid chromatography–UV (LC-UV) to study the degradation of three antihistamines: ketotifen, epinastine, and emedastine. However, ultra-performance liquid chromatography–mass spectrometry/mass spectrometry (UPLC-MS/MS) was used to identify the degradation products of these antihistamines.

High-performance liquid chromatography (HPLC) was used to simultaneously determine sildenafil, vardenafil, udenafil, avanafil, and tadalafil in tablets and honey. However, 20-hydroxyecdysterone and turkesterone in dietary supplements (in the plant species *Rhaponticum carthamoides Willd.*, *Cyanotis arachnoidea,* and *Ajuga turkestica*), as well as in capsules and tablets, were quantitatively determined using a newly developed reversed-phase high-performance liquid chromatography (RP-HPLC) method with gradient elution. An RP-HPLC method was also developed for the simultaneous determination of chlorogenic acid, caffeic acid, chicoric acid, ferulic acid, apiin, rosmarinic acid, lutein, and β-carotene in *Lactuca sativa,* grown using conventional agriculture methods and smart farm agriculture methods. One of the most frequently detected undeclared substances in dietary supplements used to support weight loss is sibutramine. Thus, to detect and quantify sibutramine in dietary supplements, a fast, sensitive, and reliable gas chromatography–mass spectrometry (GC-MS) method was developed.

The volatile components in the *Hypericum perforatum* herb were determined using the headspace solid-phase microextraction coupled with gas chromatography–mass spectrometry (HS-SPME-GC/MS) method. It was shown that the method of drying the herb affects the profile of the determined volatile components. The characterization of melanin from *Echinacea purpurea* was based on an analysis of the thermal decomposition products of a well-purified pigment extracted from the dried herb. The analysis was performed using the pyrolysis–gas chromatography/mass spectrometry/mass spectrometry (Py-GC/MS/MS) method. *E. purpurea* most likely produces three structurally different melanin pigments: allomelanin, eumelanin, and pheomelanin. Another group of publications was devoted to the study of contaminants found in food. The solid-phase extraction high-performance liquid chromatography–photodiode array (SPE-RPHPLC-PDA) method was used to determine the presence of phthalates (dimethyl phthalate, diethyl phthalate, dipropyl phthalate, and dibutyl phthalate) in water stored in plastic bottle, and it was found that most phthalates were present [13]. The next article compared two extraction procedures for the analysis of phthalates in hot drinks from coffee and tea machines. Seven phthalates (bis(2-ethylhexyl) phthalate, dibutyl phthalate, diisobutyl phthalate, benzyl butyl phthalate, dimethyl phthalate, diethylphthalate, and dioctyl phthalate) were analyzed and determined using gas chromatography with flame ionization (GC-FID). Bai et al. [14] applied the entire procedure to the matrices of hot drinks, e.g., coffee, decaffeinated coffee, barley coffee, coffee with ginseng, and tea. The high-performance liquid chromatography–mass spectrometry/mass spectrometry (HPLC-MS/MS) method was used to determine 21 trace pesticides in tea drinks.

Reversed-phase thin-layer chromatography (RPTLC) was found to be an excellent method for examining the lipophilicity of a group of newly synthesized 1,2,3-triazole-dipyridothiazine hydrids, which have anti-cancer properties. RP-HPLC was used to investigate the lipophilicity of antifungal isoxazolo [3,4-b]pyridin 3(1H)-one derivatives.

The next publication described the most important factors affecting the liquid–liquid extraction of ciprofloxacin, moxifloxacin, and levofloxacin.

Another publication presented ethanol concentrations in samples of unground costal cartilage, ground costal cartilage, femoral venous blood, and urine analyzed by gas chromatography–flame ionization (GC-FID).

In all publications, the newly proposed methods for the determination of biologically active substances were validated by checking their specificity, linearity, limit of detection (LOD), limit of quantification (LOQ), precision, accuracy, and robustness in accordance with the procedure set out in the International Conference on Harmonization (ICH) guidelines [15].

The review article will familiarize readers with the importance of chromatographic methods in pharmaceutical analyses.

I strongly encourage all chemists and pharmacists to read the publications included in this Special Issue of *Processes* on "Applications of Chromatographic Separation Techniques in Food and Chemistry".

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