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Editorial

Analysis of Natural Bioactive Compounds in Plant, Food, and Pharmaceutical Products Using Chromatographic Techniques

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1. Introduction

A growing tendency toward the discovery and use of natural bioactive compounds that are the least harmful, have the fewest side effects, and are the most natural for the human body has been noticed during the past few decades [1]. As evidenced by the rise in recent studies on the therapeutic properties of plants, this trend has caused a return of healthcare professionals to nature and plants, but with a modern approach that specifically questions how plants help to heal humans and what their exact effects on the human body are [2]. The medicinal properties of plants are related to their phytochemical makeup, which is a complex matrix with a large number of naturally occurring bioactive molecules that must be distinguished between in order to be identified [3,4]. The separation of natural bioactive chemicals from plants can be accomplished utilizing cutting-edge, high-tech, hyphenated chromatographic approaches, which also provide us with lots of information to be able to identify compounds [5–7]. In order to explain a plant's mechanism of action and therapeutic effect, modern healthcare providers need to be able to link the phytochemical profile of a plant employed in therapy to a biological activity [8]. In addition to plants, natural bioactive substances can be found in a variety of foods and pharmaceuticals [8,9]. As a result, it is crucial to analyze these chemicals in plant, food, and pharmaceutical products [8–10].

In order to identify and analyze natural bioactive compounds in plant, food, and pharmaceutical products, this Special Issue has attempted to compile the latest improvements, advancements, and analytical innovations in chromatographic techniques. Additionally, this Special Issue seeks to enable researchers to link the phytochemical profiles of plants, foods, and pharmaceuticals with proven therapeutic effects, which may later substantiate the health-related claims made for these products. This Special Issue includes 10 research articles focused on the analysis of natural bioactive compounds and phytochemicals in plant, food, and pharmaceutical products using innovative chromatographic techniques.

2. Overview of Published Articles

This Special Issue begins with an article by Mohiuddin et al. [11], who studied the chemical composition and antibacterial effects of *Cerana indica* propolis from the Kashmir region. GC-MS analysis was performed to identify the chemical compounds of Kashmiri propolis, and showed the presence of 68 different phytochemicals in Kashmiri propolis. The ethanolic extract of Kashmiri propolis showed the maximum zone of inhibition against *Staphylococcus aureus*. The findings of this research indicate the presence of various secondary metabolites with distinct pharmacological activities.

Abdel-Baki et al. [12] next assessed the chemical constituents, in vitro cytotoxicity, and scolicidal, acaricidal, and insecticidal activities of *Lavandula steochas* essential oil. The phytoconstituents of *L. steochas* essential oils were detected using spectrometry and gas chromatography techniques. The analyses of *L. steochas* oil showed camphor as being the major compound (58.38%). The oil presented significant cytotoxicity and scolicidal activities. The essential oil also showed 100% adulticidal activity against *R. annulatus* at a

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10% concentration, whereas the larvicidal activity was 86.67%. However, the oil showed no insecticidal activity. In addition, *L. steochas* oil demonstrated 100% larvicidal and pupicidal effects. The findings of this work suggest that *L. steochas* essential oil could serve as a potential source of scolicidal, acaricidal, insecticidal, and anticancer agents.

Haq et al. [13], in the next article, developed and validated a greener, stability-indicating, high-performance liquid chromatography (HPLC) approach to determine curcumin (CCM) in an in-house developed nanoemulsion, *Curcuma longa* L. extract, and marketed tablets. The greener HPLC approach was found to be linear, rapid, accurate, precise, and sensitive for measuring CCM. The AGREE approach showed an AGREE score of 0.81 for the proposed HPLC method, which indicated an outstanding greenness profile. The proposed HPLC method successfully determined the CCM in the in-house developed nanoemulsion, *Curcuma longa* extract, and commercial tablets. Furthermore, the greener HPLC method was found to be stability-indicating. The results of this work indicate that CCM can be routinely measured in all studied sample matrices using the greener HPLC method.

The capillary electrophoresis (CE) technique with light-emitting diode-induced fluorescence detection was used for the analysis of sugars in honey samples by Andrasi et al. [14]. The optimized CE technique was applied in the measurement of fructose and glucose via the direct injection of honey samples. The proposed CE technique provides high separation efficiency and sensitivity within a short analysis time. Furthermore, it enables the injection of honeys without sample pretreatment. The findings of this study showed the rapid and sensitive analysis of sugars in honey samples using the CE technique with fluorescence detection.

Altharawi et al. [15] developed and validated an UPLC-MS/MS method for the simultaneous determination of neratinib and naringenin in rat plasma using imatinib as the internal standard (IS). The mass spectra of studied compounds were recorded via the multiple reaction monitoring of the precursor-to-product ion transitions. The proposed UPLC-MS/MS method was found to be linear, selective, precise, accurate, and stable. The proposed method was also found to be eco-friendly for the measurement of neratinib, naringenin, and IS. The analytical results of this work showed that the developed method has implications for its applicability in pharmacokinetic studies in humans to support the therapeutic drug monitoring of combination drugs.

Haq et al. [16] developed a rapid and sensitive HPLC approach for the determination of a natural bioactive compound, pterostilbene (PTT), in commercial capsule dosage form, solubility, and stability samples. The developed HPLC approach was linear, rapid, accurate, precise, and sensitive. The proposed HPLC approach was successfully applied in the measurement of PTT in commercial capsule dosage form, solubility, and stability samples. The results indicated that PTT in commercial products, solubility, and stability samples may be routinely determined using the proposed HPLC approach.

In another article, Suleman et al. [17] used two different spices, Chinese prickly ash and cinnamon, to mitigate the formation of heterocyclic aromatic amines (HAAs) in superheated steam-roasted patties. The findings demonstrated significant differences ($p < 0.05$) in the content of both polar and non-polar HAAs in comparison to the control patties. In cinnamon-roasted and Chinese prickly ash patties, both polar and non-polar HAAs were considerably reduced. The results of this study showed that both spices and superheated steam controlled HAAs to a significant level in lamb meat patties.

El Adnany et al. [18] improved the extraction efficiency of phenolic compounds from olive leaves (*Moroccan picholine*) while minimizing the use of harmful chemicals. Ultrasonic extraction using ethanol was found to be the most effective and environmentally friendly approach. The antioxidant activity of the phenolic compounds of olive leaves was also evaluated. Various parameters, such as the extraction time, solid/solvent ratio, and ethanol concentration (independent variables), were evaluated using a response surface methodology (RSM) based on the Box–Behnken design (BBD) to optimize the extraction conditions. The phenolic compounds of olive leaves were identified using the HPLC-MS

technique. Various phenolic compounds, such as hydroxytyrosol, catechin, caffeic acid, vanillin, naringin, oleuropein, quercetin, and kaempferol, were found in high concentrations. The findings of this work showed the efficient extraction of phenolic compounds with great antioxidant activity.

Zasheva et al. [19] studied the effects of *Haberlea rhodopensis* methanol extract fractions on the cell viability and proliferation of two model breast cancer cell lines (MCF7 and MDA-MB231 cells) with different characteristics. In addition to the strong reduction in cell viability, two of the fractions showed a significant influence on the proliferation rate of the hormone receptor expressing MCF7 and the triple-negative MDA-MB231 breast cancer cell lines. The results of this study presented a good background for future studies on the use of myconoside (an active constituent of *Haberlea rhodopensis*) for targeted breast cancer therapy.

In the final article, Gomez-Patino et al. [20] developed a rapid protocol for the extraction and separation of the components of the aerial parts of *Gymnosperma glutinosum*. The chemical compounds of chloroformic and methanolic extracts of *G. glutinosum* were identified using the GC-MS technique. The findings revealed the presence of (−)-α-bisabolol (BIS) as the main component in the chloroformic extract, which was isolated and analyzed via ^{1}H NMR to confirm its presence in *G. glutinosum*. The evaluation of methanolic extracts using the UPLC-MS technique demonstrated the presence of six methoxylated flavones and a group of C20-, C18-hydroxy-fatty acids. The findings of this study concluded that the presence of BIS, an important sesquiterpene with therapeutic skin effects, as well as some antioxidant compounds such as methoxylated flavones and their oils, could play an important role in cosmetology and dermatology formulations.

3. Conclusions and Future Perspectives

In the last few decades, a tremendous amount of research on the analysis of natural bioactive compounds in plants, foods, and pharmaceutical products, using a wide range of chromatography techniques, has been performed. This Special Issue has brought together prominent researchers who have explored the diverse application range of chromatographic techniques in the extraction, separation, identification, and analysis of natural bioactive compounds. This Special Issue provides sufficient information on the analysis of natural bioactive compounds in plant, food, and pharmaceutical products using chromatographic techniques. However, one article reported the pharmacokinetic profile of natural bioactive compounds using the highly sensitive UPLC-MS/MS technique. I believe that further applications of these techniques on the biological samples, pharmacokinetic evaluation, and therapeutic drug monitoring of natural bioactive compounds are still required to explore the clinical applications of these techniques. Furthermore, the correlation of identified bioactive compounds and phytochemicals with their biological activity is required and will add the advantages for future studies.

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