

# New Times Coming for the Beneficial Association between Plant Secondary/Specialized Metabolites and Human Health



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## Abstract

Plants have been used by humankind for healing. They can produce an array of bioactive compounds, called secondary/specialized metabolites, which can have different functions for plants, but also for human health. In the search for new drugs, plants are still an important source of discovery.

**Keywords:** Drug delivery system; Functional foods; Herbal medicine; Metabolomics; Plant secondary/specialized metabolism

## Introduction

For centuries, plants have been used by humankind for healing. Later, there was an interest to know the active constituents or metabolites from medicinal plants. So, isolation methods, purification techniques and structural elucidation by spectroscopic techniques were developed in order to identify these bioactive plant metabolites. Some of them have been also produced by chemical synthesis; others have been improved by chemical modifications (semi-synthesis) or substituted by analogues of the active principles. Although, semi-synthetic compounds replaced many bioactive plant metabolites, there were others that could not be substituted and remain as valued medicines to this day [1].

Up to date, plants are still an important source for the discovery of novel pharmacologically active compounds [2]. These bioactive compounds, named secondary/specialized metabolites, as they belong to the plant secondary/specialized metabolism, have different functions that help plants to stay healthy in their environment. Among important ecological functions in plants for many secondary/specialized metabolites are protection against herbivores and microbial pathogens, as attractants (odor, color, taste) for pollinators and seed-dispersing animals, as agents of plant-plant competition and plant-microbe symbiosis, as mechanical support, and as phytohormones [3,4]. In general, secondary/specialized metabolites are part of complex mixtures, which are often

confined to particular taxonomic groups. Moreover, their biosynthesis and accumulation are generally organ-, tissue-, cell-, development-, or stress-specific. They belong to several classes or groups of secondary/specialized metabolites; such as alkaloids, cyanogenic glucosides, alkylamides, triterpenoids, flavonoids, stilbenoids, lignins, lignans, phenylpropanoids, tannins, saponins, cannabinoids, curcuminoids, non-protein aminoacids, among others [5].

Up to date, there is a renewed interest in pharmacologically active natural products from plants, in the continued search for new drugs, but also for the use of plants as herbal medicines [1]. According to World Health Organization (WHO), an herbal medicine is defined as plant derived material or preparations with therapeutic or other human health benefits, which contain either raw or processed ingredients from one or more plants [6]. Herbal medicines have been used by the traditional system of medicine for a long time. This traditional use is commonly an integral part of culture, which was developed within an ethnic group before the development and spread of modern science [7]. The commercial value of herbal medicines on the international market is high and increasing greatly; but there is a lack of common standards, understanding and appropriate methods for evaluating herbal medicines in order to ensure their safety and quality control. Besides, there is an influence of culture and history on the use of herbal medicines, which differs from

country to country and region to region. This could have a major impact on the use of herbal medicines in modern societies [6].

To achieve the task of identification and quantification of metabolites (metabolomics) from herbal medicines or plants, there are several different analytical platform-based metabolomics, such as nuclear magnetic resonance spectroscopy- (NMR-based metabolomics), gas chromatography-mass spectrometry- (GC/MS-based metabolomics), or liquid chromatography-mass spectrometry- (LC/MS-based metabolomics), that in combination with multivariate data analysis can provide authentication (fingerprinting) and standardization of herbal medicines. Other strategy is the development of DNA-based molecular markers, which are not influenced by age, physiological conditions or environmental factors. Some examples of molecular marker techniques are Randomly Amplified Polymorphic DNA (RAPD), Sequence Characterized Amplified Region (SCAR) and Amplified Fragment Length Polymorphism (AFLP) [8]. Other important aspect that it should be considered in the herbal medicine field is the drug delivery system, which involves the methods or processes for administering a pharmacologically active plant metabolite to achieve the therapeutic effect [9]. Some of the traditional ways of drug delivery system for herbal medicine have been decoction as teas, steam baths, and soups, or tinctures. However, poor solubility, bioavailability, instability, and toxicity from herbal extracts, including for secondary/specialized metabolites, in some cases, make difficult a straight use in herbal medicine.

Nevertheless, new strategies for drug delivery systems for herbal formulations and secondary/specialized pharmacologically active metabolites have been developed in order to improve the above-mentioned difficulties. Some examples are drug delivery vehicles such as liposomes (lipids), nanoparticles, emulsions, phytosomes (phospholipids), and microspheres, among others [10]. It is worth to mention that, in some cases, there is an enhanced therapeutic effect by using whole plants or mixtures of plants rather than isolated plant secondary/specialized metabolites. A phenomenon attributed to synergistic combination or multi-factorial effects between compounds present in the plant extracts. Synergy can be given directly by a number of plant metabolites acting at different receptor targets involved in any disease. Another way through plant metabolites with little or no activity on the causative agent, assisting the main pharmacologically active plant metabolite (s) to reach the target by improving bioavailability or by decreasing metabolism and excretion. Other therapeutic effects are given by immunomodulation or modulation of side-effects, which are also activated by synergistic responses from herbal medicine [11].

Nowadays, there is a boom in the world market for functional foods or nutraceuticals. They are processed foods or foods that are enriched with particular nutrients, isolated plant metabolites or plant extracts. Usually, they are a combination of both nutritional and beneficial healthy properties from food extracts with the healing properties of natural active metabolites

[12,13]. Finally, as part of an enormous investment in research and development for applications from the plants Cannabis/hemp (*C. sativa*), cat's claw (*Uncaria spp.*) and hummingbird bush (*Hamelia spp.*), a vast array of patents have been granted in different fields, such as medicine, food, cosmetics, textiles, paper, architecture, secondary/specialized metabolite and plant extract production, and so on [14,15]. These three plants are some examples of the beneficial association between secondary/specialized metabolism and human health.

### Conclusion

Plants, especially medicinal plants, are still important sources for the discovery of novel pharmacologically active metabolites and for developing of improved bioactive metabolites. Authentication of herbal medicine and functional foods should be an important subject for the security of consumers. Human health is still linked to plants.

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