

## EDITORIAL

# BOTANICAL INGREDIENTS: THE KEY LINK IN COLOMBIA FOR THE DEVELOPMENT OF INNOVATIVE AND NATURAL PHARMACEUTICAL, COSMETIC, AND FOOD PRODUCTS

## EL ESLABÓN CLAVE EN COLOMBIA PARA EL DESARROLLO DE PRODUCTOS FARMACÉUTICOS, COSMÉTICOS Y ALIMENTARIOS INNOVADORES Y NATURALES

Botanical ingredients are widely used in food, dietary supplements, cosmetics, drugs, and other products. These ingredients may either be made as fresh material, dry and ground material, or as valorized sub-products obtained following more complex industrial process such as extraction, concentration, and purification. The plant sources of botanical ingredients are diverse. Roots, flowers, fruits, leaves, or seeds could be obtained from i) industrial crops (food and non-food); ii) wild plants (non-agroindustrial development); or iii) agroindustrial wastes (byproducts obtained during harvesting, post-harvesting, and industrial processing). Each of these sources is associated with specific challenges and advantages in the botanical ingredient industry. For example, industrial crops provide the most homogeneous raw material, but the degree of novelty and innovation in the development of these ingredients could be limited. Conversely, wild plants are the best source of novel ingredients; however, they require a lot of time and money to develop. These increased expenditures normally emerge from bioprospecting studies and legal procedures, given that the inclusion of a new ingredient is required. On the other hand, agroindustrial wastes are the most sustainable and environmentally friendly bioingredient sources; however their availability, homogeneity, and innocuousness are the most important challenges to solve.

Exploitable chemicals are as wide ranging as plant sources. Lipids, monomeric and polymeric carbohydrates, nutrients, and vitamins, as well as different groups of secondary metabolites – especially phenolic compounds, carotenes, and essential oils – have been obtained and used as non-active ingredients (emulsifying agents, dispersants, viscosifiers, diluents, colorants, and preservatives, among others) and as active ingredients (responsible for functional effects and claims).

The use of products featuring botanical ingredients are commonly associated with such concepts as “innocuity”, “functionality”, and “green chemistry”, which are highly valued in the global economy. In fact, in 2015, more than 3.5 million tons of botanical ingredients were used for the elaboration of food, personal care, and health care products with an expected annual growth rate of 2% and 7% around the world and in Colombia, respectively (1). Additionally, the chain of natural products is constantly evolving, promoting continuous innovation in the development of ingredients, mainly through: i) the increasing consumer demand for new products; ii) the final producer requiring novel and better ingredients to produce new products; and iii) the growers needing to diversify their markets. Nowadays, innovation in the botanical ingredients industry is increasingly concentrated in three main fields: i) **performance** (ingredient efficacy and functionality); ii) **storytelling** (the story behind the production of the ingredient); and iii) **sustainability** (social, economic, and environmental impacts).

The extraction process is one of the most important steps involved in ingredient production and it serves as a key factor for innovation, mainly at the performance and sustainability level. The cost, yield, selectivity, and reproducibility have traditionally been the main attributes considered in the selection of

an extraction technique. However, nowadays, the energetic and environmental sustainability of the entire process are the most predominant factors. These new developments are strongly desired to comply with environmentally friendly processes, green chemistry principles, and high-efficiency technologies (2). Recent trends in extraction technologies have focused on finding more efficient and green technologies that minimize extraction times and solvent consumption. Among them, microwave-assisted extraction (MAE), ultrasound-assisted extraction (UAE), extraction with electrotechnologies (such as pulsed electric fields, high-voltage electrical discharges, and pulsed ohmic heating), supercritical fluid extraction (SFE), and pressurized liquid extraction (PLE), generally meet these requirements (3, 4, 5). Some of these methodologies have been recently described and are used in this journal. To comply with the criteria of green chemistry concepts and sustainability, UAE and SFE are advantageous, as they are scalable processes (6, 7). Ultrasound applications have been widely developed in the industry and are still an active research field, likely because they represent a key technology in achieving the objectives of sustainable “green” chemistry. The effect of ultrasounds on extraction yields is attributed to the microstreaming and heightened mass transfer produced by cavitation and bubble collapse, resulting in cell destruction. Also, there has been more and more interest in high-power ultrasounds as an innovative, scalable, and alternative process (6).

To promote a competitive advantage in the marketplace, pharmaceutical, cosmetic, and food firms are increasingly creating products with innovative botanical ingredients or adding environmentally friendly attributes to existing products. Further, the growing demand for natural ingredients has led to the strengthening of regulations to verify the safety and efficacy of these inputs. Nowadays, denominations like ingredients Generally Recognized as Safe (GRAS); Food, Drugs, and Cosmetics (FD & C) ingredients, and the concept of functional foods and cosmetics are supported by high-quality scientific evidence and endorsed by leading European and North American regulators (including the Food and Drug Administration [FDA], the European Medicines Agency [EMA], and the European Food Safety Authority [EFSA], among others). Hence, we are facing a diverse and versatile market that is in high demand, regulated, growing, and presents great opportunities for research, innovation, and the capacity to develop new ingredients. It is therefore not surprising that the search for new natural ingredients is a hot topic that is becoming the focal point of many research efforts.

The search for new sources of natural ingredients is an attractive alternative in highly diverse countries such as Colombia. However, the impact of our megadiversity has not yet been reflected in improvements at the socioeconomic level, nor does our diversity constitute a competitive advantage in the international market of natural products. Paradoxically, the Colombian regions of Choco and Amazonia have the greatest diversity of flora and they are the least developed regions at the socioeconomic level. In addition, much of the products marketed as phytotherapeutics in Colombia come from foreign species introduced in our territory. Thus, suppliers of local natural ingredients for cosmetic, phytotherapeutic, and food purposes do not reflect Colombian diversity in their catalogs. In fact, fruit extracts representative of our biodiversity that are approved for use as cosmetic ingredients (Cosmetic Ingredient [CosIng] database– European Commission) are practically impossible to find from national suppliers. Even more limited is the outlook for exotic and endemic species that do not undergo significant agricultural development.

To put things in perspective, one way to increase the presence of innovative products in the pharmaceutical, cosmetic, and food markets is to introduce innovative botanical ingredients that are primarily cultivated from our biodiversity or local growers. Therefore, exploiting our natural resources entails overcoming major challenges, primarily when achieving sustainable development framed in the establishment of national and international markets. To capitalize on favorable attitudes toward botanical ingredients, the University of Antioquia, with the support of Colciencias, devised a private public strategy to implement a technological platform employing high-power UAE to scale and prototype innovative botanical ingredients. With that, we expect to contribute to the development of this potential sector in Colombia.

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