

## Chapter 20

# Phytonutrients of Nutraceutical Importance: Exploring Antimicrobial, Antiproliferative, and Antioxidant Activities

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### ABSTRACT

*Phytotherapy re-emerged in the latest years as a healing system accepted and spread worldwide, and different molecules have been investigated due to their benefits to health. Nutraceutical formulations, which allow the intake of phytonutrients (generally in low levels in plant food) in concentrations that are enough to achieve the desired outcomes, represent feasible alternatives to improve general health and to prevent and treat varied diseases. Notwithstanding the incompleteness of an evidence-based clinical use of nutraceuticals, many questions remain unanswered regarding their global effects in humans and animals. Thus, the aim of this chapter is to provide recent evidence on chemical and pharmacological features of the main phytonutrients explored in nutraceutical formulations, focusing antimicrobial, antioxidant and antiproliferative potentials. Also, some insights on drug-phytonutrients interactions will be discussed.*

### INTRODUCTION

The rapidly increasing knowledge on nutrition, pharmacology and plant biotechnology has changed some concepts about food and health. Epidemiologic studies from the latest 50 years have provided evidence of an inverse association between the dietary intake of fruit and vegetables and occurrence of varied illness such as diabetes, osteoporosis, cancers, cardiovascular and infectious diseases. This protective effect obtained in food intake has been assigned to plant secondary metabolites; specifically, phytomol-

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ecules with nutritional properties, the phytonutrients. In a few words, phytonutrients can be defined as plant-derived compounds with nutritive properties that can have also curative or preventive effects over diseases (Michels et al., 2000). These phytomolecules are thought to be responsible for most of the health benefits observed in individuals that adopted long-time diets rich in fruits, vegetables, beans, cereals, and plant-based beverages such as tea and wine. The correlation between observed effects and the type or concentration of some phytomolecules has been described, such as Lycopene and Resveratrol, for instance, in cancer prevention. In plants, several phytomolecules of nutraceutical interest are part of defense mechanisms against environmental challenges such as damage due to ultraviolet light exposure and natural predators such as insects and other plagues (Hecht, 2000; Sharma et al., 2009).

The low bioavailability of phytomolecules is an important limitation on their use to prevent or treat diseases. The often low concentration found in plasma has led to some skepticism in this sense; however, in spite of their low bioavailability, varied studies in the latest years have provided evidence of their beneficial effects in humans and animals. To overcome the issue of low levels of phytonutrients in fruits and vegetables, pharmaceutical and nutritional companies have developed several pharmaceutical dosage forms of nutraceutical formulations and other dietary plant-based supplementary products. This becomes even more relevant considering that nutraceutical formulations provide adequate concentrations of phytomolecules and thus, different beneficial effects to health can be expected. Moreover, nutraceutical formulations make the use of phytonutrients feasible in a clinical perspective (McCullough et al., 2003; Key et al., 2004; Yang et al., 2010). Examples of Nutraceuticals are presented in Table 1.

The Dietary Supplement Health and Education Act, adopted by the American Association of Clinical Endocrinologists (Mechanick et al., 2003), provides adequate definitions of dietary supplements and nutraceuticals, which will be adopted and slightly adapted in this chapter for a better comprehension by non-specialist readers. According to Mechanick et al. (2003), dietary supplements comprise five main groups of ingredients/elements:

1. Vitamins or minerals;
2. General phytomolecules;
3. Amino acids;

*Table 1. Examples of phytomolecules-based nutraceutical formulations*

Formulation Brand	Phytomolecules	Manufacturer	Indications
Inneov Solar®	β-carotene, Lycopene, tocopherols and <i>Polypodium leucotomos</i> extract	Loreal and Nestlé	Oral photoprotection
Lauricidin®	Lauric acid	Med-Chem	Stimulation of the immune system
Extra-Strength Broccoli Extract with Glucosinolates®	Glucosinolates of broccoli extract	Green Foods	ROS/RNS scavenger, protection of the cardiovascular system
Flavonoid 1000®	Hisperidin, rutin, bromelin and citric bioflavonoids (200, 50, 50, 1000 mg, respectively)	DaVinci	Relief on varicose veins, reduction of inflammatory processes associated to pain, metabolism booster.

ROS: Reactive oxygen species; RNS: Reactive nitrogen species.

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