Chapter 26
Plant-Derived Compounds and Their Potential Role in Drug Development

Dimitrios Kaloudas
Sofia University "St. Kliment Ohridski", Sofia, Bulgaria

Robert Penchovsky
Sofia University "St. Kliment Ohridski", Sofia, Bulgaria

ABSTRACT

This article describes how with the development of biotechnology, plants have gained again a prominent place as a relatively inexpensive source for the creation of recombinant pharmaceuticals. Plant-derived compounds have started playing a major role in the pharmaceutical industry with many plant-based products to have found their way in drugs and chemicals used for the treatment of different diseases and their symptoms. Plant-derived compounds have been tested for the treatment of several types of cancer, Central Nervous System disorders, as enhancers during chemotherapy and as vessels for targeted drug delivery. Genetically modified plant cells have been recruited for the production of therapeutic agencies as well as in the creation of expression systems for virus-like particles that could be used as vaccines. Moreover, microRNAs mimicking the plant ones have the ability to inhibit tumors in mammalian cells. This review describes plant-derived compounds and their properties as potential therapeutic agents and precursors for the development of novel drugs in the pharmaceutical industry.

INTRODUCTION

Nature's botanical medicines were exercised by the humans from the early times. Plants and their extracts were used as painkillers, relaxing or trance-inducing state agents, hallucinogens for spiritual enlightenment, and for the treatment of diseases. Nowadays plants play a major role in the research and development of various therapeutic agents, including the treatment of the HIV (Cichewicz & Kouzi, 2004) and neurodegenerative diseases like Parkinson's and Alzheimer (Eckert, 2010; Hassaan et al., 2014; Rios,

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Onteniente, Picazo, & Montesinos, 2016). At the beginning of the modern medicine, plant-based compounds were used for the production of the first drugs such as the morphine (Courtwright, 2009). Until the era of the synthetic medicals and the production of the antibiotics (Blount, Puskarz, Penchovsky, & Breaker, 2006; Robert Penchovsky & Stoilova, 2013; R. Penchovsky & Traykovska, 2015), plant substances were the basis of the early medicines and still nowadays in undeveloped areas of the word botanical medicines are still being exercised. With the thriving of biotechnology, plants have become again a target for the development of plant-based pharmaceutical agents and drugs. In comparison to the methods used for bacterial and mammalian cell cultures, plants have become a prominent research subject as there are relatively inexpensive to grow, maintain and can be easily scaled up to produce large product quantities (Twyman, Schillberg, & Fischer, 2005), an important aspect for the production of pharmaceutical products of high demand that greatly needed in the developing countries (Sparrow, Irwin, Dale, Twyman, & Ma, 2007). Plant compounds have been tested nowadays in various treatments including, antibacterial and antiviral actions, Central Nervous System (CNS) disorders, chemotherapy enhancers and cancer therapies.

PLANT COMPOUNDS AND CHEMOTHERAPY

Natural products have been a major resource for cancer therapy and are sources for the production of new drugs that have been designed to target tumor-related proteins. One of the major issues in chemotherapy is the non-specific toxicity of the toxic therapeutics been use for the treatment of tumors and the chemoresistance of the targeted cancer cells that can lead to tumor recurrences or even patient's death (L. N. Abdullah & Chow, 2013). In recent researches, plant phytochemicals have shown that have the ability to overcome problems been associated with chemotherapy that targets the healthy cells. Application of these plant-derived compounds before the classical chemotherapy can improve the strength of the treatment, increase its pharmacotherapy and reduce its toxicity. Vinca (or Catharanthus) alkaloids, epipodophyllotoxins, taxanes, and camptothecin are the four major classes of plant-derived anticancer agents in clinical use. Alkaloid compounds, epipodophyllotoxins and taxanes arrest cell growth by binding to the tubulin filaments and halting the cell cycle (Gordaliza, Garcia, del Corral, Castro, & Gomez-Zurita, 2004; Okouneva, Hill, Wilson, & Jordan, 2003) while camptothecin acts by selective inhibition of the topoisomerase I that involves in the cleavage and reassembly of the DNA (Cragg & Newman, 2004). Veratridine, an alkaloid-derived compound from the Liliaceae plant has shown to bear anti-tumour properties by increasing the expression of the UBXN2A protein, which inactivates the oncoprotein mortalin2 by binding on to it. Mortalin2 targets the tumour suppressor protein p53 for proteasomal degradation (Figure 1). The combination of the veratridine with standard chemotherapeutic agents 5-Fluorouracil (5-FU) and etoposide resulted in higher effectivity of the therapeutic treatment as the veratridine had a synergistic effect with the chemotherapy agents. In 50% of colon cancer patients, the levels of the UBXN2A protein were reported as being significantly lower in the cancer cells than it is in the adjacent normal ones. This is indicative that veratridine can be targeting tumour-specific cells possessing low expression levels of the UBXN2A leaving the healthy tissue intact while it can be used together with the standard chemotherapy agents to improve treatment's efficiency in colon cancer patients that preserve the wild-type tumour suppressor p53 protein (A. Abdullah et al., 2015). In ovarian cancer, the treatment with taxane and platinum drugs of the epithelium, often results in severe systemic toxicity. Quercetin, a plant polyphenol, had been reported to work synergistic with chemotherapy drugs (cisplatin