

REVIEW

Open Access



Anticancer potential of alkaloids: a key emphasis to colchicine, vinblastine, vincristine, vindesine, vinorelbine and vincamine

Praveen Dhyani¹, Cristina Quispe², Eshita Sharma³, Amit Bahukhandi⁴, Priyanka Sati⁵, Dharam Chand Attri⁴, Agnieszka Szopa⁶, Javad Sharifi-Rad^{7*}, Anca Oana Docea⁸, Ileana Mardare⁹, Daniela Calina^{10*} and William C. Cho^{11*}

Abstract

Cancer, one of the leading illnesses, accounts for about 10 million deaths worldwide. The treatment of cancer includes surgery, chemotherapy, radiation therapy, and drug therapy, along with others, which not only put a tremendous economic effect on patients but also develop drug resistance in patients with time. A significant number of cancer cases can be prevented/treated by implementing evidence-based preventive strategies. Plant-based drugs have evolved as promising preventive chemo options both in developing and developed nations. The secondary plant metabolites such as alkaloids have proven efficacy and acceptability for cancer treatment. Apropos, this review deals with a spectrum of promising alkaloids such as colchicine, vinblastine, vincristine, vindesine, vinorelbine, and vincamine within different domains of comprehensive information on these molecules such as their medical applications (contemporary/traditional), mechanism of antitumor action, and potential scale-up biotechnological studies on an in-vitro scale. The comprehensive information provided in the review will be a valuable resource to develop an effective, affordable, and cost effective cancer management program using these alkaloids.

Keywords: Alkaloids, *Vinca*, *Catharanthus*, *Colchicum*, Anticancer, Microtubule-targeting agents, Antimitotic, Apoptosis

Introduction

Cancer, a rapid formation of abnormal cells in an uncontrolled manner due to various modifications in gene expression, is one of the leading illness-related deaths worldwide [1–3]. In 2020, it accounted for nearly 10 million deaths globally, comprising a major portion of breast cancer > Lung cancer > Colon and

rectum cancer > Prostate cancer > Skin cancer > and Stomach cancer related new cases (<https://www.who.int/news-room/fact-sheets/detail/cancer>). Today, chemically derived drugs treatment along with chemotherapy and radiotherapy constitute different components of cancer treatment, with chemo being adverse to healthy cells [4–6]. A comprehensive treatment of cancer is usually available in 90% of high-income countries, but it is only 15% in low-income countries, thus putting a tremendous economic cost on treatment (WHO, 2020). In 2010 alone, the total economic cost of cancer was estimated to be US\$ 1.16 trillion [7]. Nevertheless, many cancers have a high chance of being cured if diagnosed early and treated appropriately [8, 9]. A 30–50% of cancers can be prevented by avoiding risk factors

*Correspondence: javad.sharifirad@gmail.com; calinadaniela@gmail.com; chocs@ha.org.hk

⁷ Facultad de Medicina, Universidad del Azuay, Cuenca, Ecuador

¹⁰ Department of Clinical Pharmacy, University of Medicine and Pharmacy of Craiova, 200349 Craiova, Romania

¹¹ Department of Clinical Oncology, Queen Elizabeth Hospital, Kowloon, Hong Kong, People's Republic of China

Full list of author information is available at the end of the article



© The Author(s) 2022. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.