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# Nutraceuticals in Colorectal Cancer: A Mechanistic Approach

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## Abstract

Colorectal cancer (CRC) is one of the most diagnosed cancers in the world. Even though screening, surgery and oncology have greatly advanced, CRC is still one of the leading causes of cancer deaths, with 700,000 annual mortalities in both men and women. Environmental and lifestyle factors brought up by industrialization, such as an altered diet, lack of physical activity, increase in alcohol consumption, and circadian disruption, have greatly affected the burden of CRC. These factors increase the CRC risk, at least partly, by pathologically altering the colonic environment, including composition of the gut microbiota, referred to as dysbiosis. Colonic dysbiosis can promote pro-carcinogenic immune signaling cascades, leading to pro-tumorigenic inflammation, carcinogen production, and altered cellular responses in susceptible host resulting to development and/or progression of CRC. Nutraceuticals such as prebiotic molecules and probiotic bacterial species can help maintain intestinal microbial homeostasis and thus mitigate this pathological processes. Therefore, prebiotics and probiotics can hinder the effects of dysbiosis by encouraging anti-carcinogenic, anti-inflammatory immunity, the maintenance of the intestinal epithelial barrier, pro-apoptotic mechanisms, and carcinogen inactivation. In addition to its implications in preventing CRC, because of the mechanisms affected, nutraceuticals are being discovered as potential adjuncts to immune checkpoint inhibitors in the treatment of CRC. In this review, we provide an overview of the potential implications of prebiotics and probiotics in the prevention and treatment of CRC.

Keywords: Nutraceutical, prebiotic, probiotic, immunity, mechanism, treatment

## 1. Introduction

Colorectal cancer (CRC) is one of the most diagnosed cancers in the world (Kolligs, 2016). In 2012, 1.4 million cases of CRC were diagnosed worldwide (Tabung et al., 2017). CRC remains one of the leading causes of cancer deaths, with 700,000 annual mortalities in both men and women (Raskov et al., 2017; Torre et al., 2015). Certain genetic and epigenetic factors have been identified to contribute to the onset of CRC. However, up to 70% of all CRC cases are sporadic, attributed to environmental factors such as poor diet (i.e. low in fiber and high in fat), metabolic syndrome (i.e. diabetes mellitus, and obesity), and physical inactivity that are mostly associated with industrialization (Vipperla and O'Keefe, 2016). Indeed, the burden of CRC has greatly increased in countries that have adopted the social and economic characteristics of industrialization (Torre et al., 2015). Studies in the past decade revealed that such lifestyle associated factors can affect colorectal carcinogenesis, at least in part, via altering the

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